VOL. XX] [No. 6.

THE

INDIAN FORESTER;

A MONTHLY MAGAZINE

OF

FORESTRY,

AGRICULTURE, SHIKAR & TRAVEL

EDITED BY

J. S. GAMBLE, M.A., F. L. S.,

CONSERVATOR OF FORESTS, AND DIRECTOR OF THE FOREST SCHOOL, DEHRA DÚN.

JUNE, 1894

MUSSOORIE.

PRINTED BY THE MAFASILITE PRINTING WORKS COMPANY, "LIMITED."

1894.

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THE

INDIAN FORESTER.

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Vallombrosa and the Royal Italian Forest School.

On the Eastern banks of the Arno, a mile from the city gates, rises a small hill, on whose crest are to be found the ancient remains of Fiesoleum, a name not unknown to the student of Roman History, and interesting as having formed the first beginnings of the present city of Florence.

The slopes of the Hill of Fiesole are studded with picturesque villas, (everyone has lately heard of Villa Palmieri and Villa Fabbricotti, Queen Victoria's temporary abodes), from which enchanting views of the Arno valley are to be obtained ; but nothing can equal the view from the summit of the hill itself. Florence, spread along the banks of the silvery Arno, brings to one's mind thoughts of some ancient walled citadel, though in this case encompassed by a wall of mountains, the blue Apennines. On the north these rise to a great height, culminating in Monte Morello, a prominent eminence, on which the eye must often rest, if only on account of the saying that when Monte Morello is capped with clouds, the wise Florentine should not forget his umbrella.

Towards the close of autumn, as the usually bright and sunny Florentine winter sets in, from Fiesole's breezy outlook, facing to the south, may often be seen in the far distance on a rising point of the Apennines, a patch of white snow, rendered the more conspicuous by the black ground on which it appears to lay. That is Vallombrosa, the valley of shade, the abode of the Royal Italian Forest School, a place unrivalled for the beauty of its scenery and of its woods, and to which we now propose to proceed.

Leaving Florence by the Rome express, the so-called 'lightning train,' (*treno lampo*), at 7-30 A. M., the passenger alights at the

little station of St. Ellero at 9 A.M. Here a small mountain train is in readiness to take him to the heights above. The railway line is constructed on the rack system, *à cromallière*, as it is termed by the patentee, Count Telfener, the constructor of this railway. The line, which is 8 kilometres in length from St Ellero to Saltino, rises very abruptly, and in places the slope reaches an inclination of 22 per cent. The wagons, which are 11 metres in length, and 2·30 metres broad, are capable of seating 56 passengers, the train being generally made up of 2 carriages, which are pushed forward by an engine attached behind. By the time the first station, Donnini, is reached, distant 3 kilometres from St. Ellero, the train has already risen 326 metres above sea level. At Filiberti, the second station, about 1½ kilometres from Donnini, the height reached is 518 metres. From this place the slope increases, and after rising for a distance of about 3 more kilometres, the terminus, situated on the small plateau level of Saltino, which is 1,000 metres, is reached.

The Railway itself is said to be of the safest, both in the system adopted, the *cromallière*, and in construction; and the line is carefully guarded by "Choukidars" placed at close and regular intervals. Still the traveller may well feel ill at ease, and feel that he is tempting Providence when crossing some of the grander passes where space, and space alone, appears to intervene between him and the abyss below. But the traveller in these parts may trust himself with confidence to the Providence, which if the local legends be credited, has often intervened in a miraculous manner to preserve the unwary pilgrim. Close to Saltino itself, near the Paradisino, is to be found a rock bearing the impression of "Saint" Giovanni Gualberto. History relates that "Shaitán" one day to please a wicked whim wished to push the saint into a torrent, but the man of God leant against a stone, which lay close by, and the stone at once becoming soft as wax, enabled it to receive his body and hold it back from the abyss. But, on the other hand, the wicked may well shudder; for at one of the worst points is not the so-called "Masso del Diavolo" pointed out to this day? So-called, because when the monastery at Vallombrosa was first started, a novice fled, wishing to return to the world; but no sooner had he removed his monk's attire than the Demon appeared and threw him into the horrible chasm below. A long and beautiful inscription bears faithful record of this occurrence. At any rate on our journey, we may well hope that if an accident does occur, all the rocks will doubtlessly turn to wax.

Many are the writers who have described the beauties of this valley; but for a description of the journey, the ride from St. Ellero to Saltino, the words of a well-known Italian writer, Raffaele de Cesare, may well be quoted:—

"Along the winding road, which leads from Pontasieve to Vallombrosa, each turn lends enchantment to the view, but when

the road enters the forests, leaving the 'zone' of the vine and the olive below, it seems to lead one into a Gothic temple, stretching to infinity. The towering pines almost entirely shut out the skies, and the road, bordered by closely-packed chestnut trees loses itself in the dark uncertain light. The forest has all the appearance of a park; the usual thickets and forest plants are wanting; the ground, in many places, is even grassless. In the denser parts of the wood, no air, no light for undergrowth Right up to the monastery one marvel of scenery follows another, the more enjoyed in so refreshing and cool an atmosphere."

At Saltino, the terminus of the Rack Railway, a fine Hotel of magnificent proportions has been erected, where every comfort of modern times may be obtained: and above all, from the terrace running along the Northern face of the Hotel the view is stupendous. At one's feet lies the whole valley of the Arno, every inch to be clearly discerned, each hamlet, each castle, each house may be made out; in fact, the whole of the fertile plain of Cascia, with its hamlets of Incisa, Rignano, Figlino, San Giovanni, Montevarchi and Pontasieve Lounging on the terrace on a summer's eve, smoking a cheroot, the sunset is a sight not easily forgotten.

In connection with Saltino* and the origin of its name a sad tale is related. A certain man wearied of the cares of life, having wended his way to this spot, his last paradise, took *a little jump* into the precipice below. If it is indeed true that this legend has given its name to the place, it is certainly equally true that it has not imparted to it any of its melancholy sadness.

From the Hotel at Saltino a short stroll leads one by a good road, the same along which we may imagine *San Giovanni Gualberto* himself first came, though the original path has lately been enlarged, planted with shady trees, to Vallombrosa, the site of the old monastery, the present Royal Italian Forest School.

Nine centuries ago young Giovanni Gualberto, a knight-errant, came to this spot. Wearied and foot-sore he sat him down under the pleasant shade of a beech tree, which let down its leafy boughs to surround him and protect him from all danger.

At the same time a pure crystal stream of water sprung from the roots of the tree. The Faggio Santo, the sacred beech, is still pointed out. Apparently Gualberto, either to perpetuate his gratitude for this act of grace, or taking this occurrence as a sign of heaven, set about founding an order of monks, known as Vallombrosani, who, settling down at Vallombrosa, built a monastery and rapidly increased in reputation, honour and riches.

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*Saltino=small jump (salto.)

The monastery is an enormous solidly built palace, with 3 towers, without any pretentions to architectural beauty of design, though stately in its severe outlines. There are spacious court-yards, vast porticoes, a verandah, some 50 metres in length, leading into the cells, which were to all appearance roomy and gay. The church is large and airy, but has nothing noteworthy with the exception of a number of relics, among which may be mentioned the arm of Saint Giovanni Gualberto, the founder of the order. There is in fact nothing worthy of notice unless, taking an interest in culinary matters, we enter the kitchen. Here is to be found a fireplace, which is situated in the centre of the kitchen, and reminds one of some ancient Hindu temple, for it consists of a beautifully designed "cupola," supported by 4 massive columns. At first sight it is only possible to imagine that the dome must have protected some heathen shrine; but the mind quickly turning to more wordly thoughts conjures up visions of the numberless lambs, and pigs, and wild boars, and even calves that hung up whole, must have slowly been brought to the right degree of crispness, while the happy and fat Vallombrosani monks, clothed in their loose flowing robes, sat on the platform around that central fire warming themselves, and licking their chops. O tempora! And if such was indeed the case, the monks tearing themselves from that enchanting spot, must have been somewhat rudely brought back to a sense of their position by reading over the door of the refectory the motto which still exists;—"L'Amor di Dio non consiste nel mangiare e nel bere,"—(the love of God does not consist in eating and drinking)—a saying which the monks evidently forgot in the year 1866, though perhaps not for the first time, when the decree of suppression was about to be issued. On that occasion, after selling all the lands they could, and collecting their wealth, they divided equally amongst themselves and went their way. Still it is always a consolation to think that if the church and Convent are no longer what they were, the good works of the monks remain after them; the forests remain, which defy all time.

The territory of Vallombrosa, which formerly belonged to the "Monaci Benedettini della congregazione Vallombrosana," as already stated, is to-day the property of the Domaino dello Stato, thus assuring the permanent retention of the vast forests to the State, and has utilized the old and roomy convent buildings for the housing of the Italian Forest School. There are about 50 students in the College, who after completing a special Course of study extending over 4 years, are appointed Assistant Sub-Inspectors of Forest. (Sotto—Ispettori Forestali Aggiunti). The School, which gives an excellent forest education, is under the directorship of Comm. Ing. F. Piccioli, who is doubtless well-known to all students of Continental Forestry for the number of excellent text books he has written on forest matters. He also edited for some time at considerable personal expense and cost, a Forest Magazine, which

has lately been abandoned for want of support. The assistant professors are Cav. P. Nico for Mathematics ; Sig. R Sulla for Botany ; Cav. V. Perona for Sylviculture ; Sig. Gatti Menotti Garibaldi for foreign languages, and a few others.

The lovely woods of Vallombrosa are situated on the Northern slopes of the Tuscan Apennines, and reach a height of 1,446 metres. The forest vegetation of Vallombrosa is said to be amongst the richest of Tuscany for the number and varieties of its plants, and indeed may this seem possible after a perusal of a very interesting little work, a botanical guide book to Vallombrosa, published by Lodovico Piccioli in 1888. (Guida alle escursione botaniche nei dintorni di Vallombrosa).

Many generations of men, dedicating themselves to a life of ascetism, taking under their special care the protection of souls *and of trees*, for eight centuries, used every endeavour to clothe those heights with a pleasant verdure. Bleak and desolate spots under their patient care were converted into magnificent and stately forests.

It is now over 9 centuries, as already described, since San Giovanni Gualberto first took up his abode on these heights and founded the order of Vallombrosani. Soon after its foundation many people came forward to endow the monastery with lands, chief among the donors being Corrado il Salico, a devout prince, and Ghipella, a pious court lady ; and, in the hands of the monks these lands assumed new features. It is to the monks that the transformation of those lands from mere barren wildernesses into pleasant hills, thickly clothed with forests, is due ; and one can only feel grateful to them, the more so on account of their being no longer there to reap the fruit of their labour. The students of the Forest School have taken their place, and the woods are the property of the State.

Down below, close to the bridge of Tosi, commence the chestnut woods, which, occupying the lower level, stretch far away into the Milosa plain, yielding large and luscious sweet chestnuts of excellent flavour. As the road rises, however, and Fossacormoti is reached a change in the atmosphere is already felt, and the imposing pine forests are entered ; and what at once strikes the eye *are* the wonderfully regular lines in which the pine trees, with almost truly mathematical precision, are planted. They have been described as having the appearance of a huge army drawn up in regular, open battle array. Rising still further to some open spot, the next thing which strikes the eye is the ease with which the different age classes may be distinguished, forming as they do a pleasing study in greens, a dark green for the patriarchs, a lighter green for the young men, and a very light pale green distinguishes the youngest. In these forests, which are treated on a selection system (jardinage) with rotation of

100 years, the darkest-green is the prevailing colour, for the old trees are still in the majority, and it is these older trees rising like mighty giants that lend majesty to the scene. The sight is indeed most varied, and it is impossible in a description to do full justice to a scene, which filled Milton, Ariosto, and many others with enthusiasm. Thus Ariosto describes the scene :—

" Cantan frai i rami gli angelletti vaghi,
Azzurrie e bianchi, e verdi, e rossi, e gialli..
Murmuranti ruscelli e cheti laghi,
Di limpidezza vicono i cristalli :
Una dolce aura che ti par che vaghi,
A un nodo sempre, e dal suo stile non falli.
Facea si l'aria tremolar d'intorno.
Che non potea noiar calor del giorno....."

And, in the pinewoods many are the shady spots, pictures which remind one of Doré's illustrations to Dante's Inferno, veritable abodes of nymphs and goblins—one's idea of the Walhalla of Scandinavian mythology. One particular wood, planted at the commencement of the century close to the Monastery, on the steep, precipitous slopes of a hill, where the clear pine boles, so carefully aligned at such regular intervals that they appear to form so many columns supporting the leafy dome above, cannot differ very materially from that which gave Milton some of the most sublime inspirations to Paradise Lost.

Many who will remember the correspondence which appeared in the *Pioneer* a few years ago regarding the acts of vandalism the Indian Forest Department were supposed to be perpetrating by felling some of the old and picturesque trees in the Dún, may appreciate the following extract from an Italian paper the *Corriére di Napoli* :—

" Neither the Alps nor the Pyrenees can offer so stupendous a sight, and, perhaps it is, alas, more than certain that Vallombrosa itself will be able to offer it no longer when with the lapse of time, the beautiful century-old trees of the woods planted by the monks will have been replaced by the less regular plantations, made with less patience, of the Forest School."

Unfortunately those who have visited the magnificent and picturesque, "scientifically" formed German forests cannot feel any alarm or be moved by such writings.

In addition to the chestnut and pine forests, far away on the Eastern limit of the Pine, the zone of the beech is entered, forming many interesting woods.

The whole of the Government estate is easily accessible, the Forest School having constructed good, shady and wide roads, and paths leading to the more inacessible and steeper points. Needless to say that the number of walks and excursions from the Hotel is endless : a climb to admire the sunrise at Secchietta, the

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ON THE

ADVANTAGES OF UNDERPLANTING

THE

LIGHT-DEMANDING, THINLY-FOLIAGED SPECIES

OF

FOREST TREES.

BY

JOHN NISBET, D.Oec.,

OF THE INDIAN FOREST SERVICE; AUTHOR OF "BRITISH FOREST TREES AND THEIR SYLVICULTURAL CHARACTERISTICS AND TREATMENT," TRANSLATOR OF KAUSCHINGER-FURST'S "PROTECTION OF WOODLANDS," ETC.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

1893.

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ON THE

ADVANTAGES OF UNDERPLANTING

THE

LIGHT-DEMANDING, THINLY-FOLIAGED SPECIES

OF

FOREST TREES.

ONE of the most important principles of sylviculture is the conservation of the productive capacity of the soil, and it is only when measures are carried out in that direction that a permanent sustained yield of the best classes of timber is possible. The first step towards the practical attainment of this object is undoubtedly the protection of the soil against insolation by means of a leafy canopy giving shade, and also against the drying action of winds by means of a covering of dead leaves and *humus* or vegetable mould. Certain thickly-foliaged forest trees, like the beech, spruce, Douglas, Nordmann's, and silver firs, are naturally endowed with the requisite soil-protective qualities throughout their whole period of development until maturity. But many of our most valuable species, like oak, ash, maple, birch, larch, and pine, lose their power of protecting the soil at a comparatively early age, long before they attain their normal maturity as forest crops; and in consequence of the interruption that takes place in their canopy, the effects of insolation and of the action of wind and rain on the soil tend to weaken its productive power, and, if unchecked, ultimately lead to its deterioration sooner or later.

To counteract the natural consequences of early interruption of canopy due to increased individual demands for light and growing-space, the best means at hand consist in the under-planting of forests of light-demanding trees with other species

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content with less supplies of light, air, and warmth. Through the foliage of these the soil is kept cool and moist, whilst a good layer of vegetable mould is further provided for the enrichment of the soil by the annual defoliation of the leaves or needles; the direct influence of this measure makes itself apparent in the more annual rapid increment on the standards.

In the naturally open forests of oak, for example, there is usually some spontaneous undergrowth; but when this consists of brushwood or scrub its beneficial influence is by no means so marked as in the case of artificially-formed underwood consisting of beech or hornbeam. The first recorded occasion on which underplanting of oaks was carried out for the express purpose of "*giving a covering of fallen leaves to a soil already* " *overgrown with whortleberry, and thus strengthening its* " *productive capacity and stimulating the diminished incre-* " *ment of the oaks,*" took place in the Spessart Forest in Central Germany about 1840,* but since then the practical advantages of such a measure have not failed of recognition, as it leads to considerable financial improvement in the further development of the standards.

There are, however, two distinct methods in which the measure can practically be carried out. The undergrowth may have solely the object of temporarily retaining or improving the productive capacity of the soil; or it may be formed with the intention of allowing it to grow up and ultimately form a portion of the crop which is to be harvested in its full maturity at the end of the period of rotation. In the latter case it also affords the sylviculturist the opportunity of forming mixed instead of pure forests for the succeeding crop, and thereby obtaining a class of forest which certainly needs more attention in the way of tending, but has many solid advantages over pure forests in yielding larger crops of greater technical value, and in comparative immunity from the attacks of insect enemies and of fungoid diseases.†

But although the practical advantages of underplanting should have been apparent to all, there were not wanting those who condemned the measure on the ground that the undergrowth consumed the nutriment available in the soil in place of stimulating the standards to enhanced increment, whilst at the same time it often entailed considerable outlay.‡ These objections

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* See "*Monatschrift für Jagd-und Forstwesen,*" 1874, page 1.

† See essay "*On Mixed Forests, and their Advantages over Pure Forests,*" pages 5–18.

‡ See Borggreve in "*Forstliche Blätter,*" 1877, page 220, and 1883, page 41.

have, however, fortunately brought the matter under the notice of the experimental section of the Forest Branch of the Faculty of Economic Science in Munich University, and in the following pages a short resumé will be given of the results of the investigations made, and the practical deductions drawn from the observations recorded.

Objections raised by Opponents of Underplanting.

The experiments on which the opponents of underplanting based their objections were of three classes :—

I. Experiments made with standards over coppice.

II. Observations recording the rate of growth in forests that had been underplanted for some time, and comparison with the rate of growth in other portions of the same timber crops that had not been underplanted.

III. Clearance of underwood in forests that had been underplanted, and comparison of the increment of the standards in the following year with that of those growing over underwood.

Borggreve maintained as regards I. that the increase attained in the breadth of the annual rings was only apparent up till the fifth year, whilst after that a decrease in the breadth was noticeable as soon as the underwood began to form canopy, and that the decrease became more marked with the increasing density of the canopy. He contended that the initially-enhanced increment was due to the diminution in the number of individual plants enjoying insolation and utilising the nutriment of the soil, and had nothing to do with the quicker decomposition of the dead foliage; he even maintained that the formation of *humus* or vegetable mould was interfered with by the full exposure to sun and wind, and to the extremes of moisture, and temperature, which hindered the normal development of fungoid growth. As, however, the degree of insolation of the standards could not be affected by the removal of the coppice growth, the enhanced increment during the following five years must have been due to the more rapid formation of humus, and consequently to larger supplies of nutrient salts in the soil in a soluble condition, resulting from the decomposition of the layer of fallen leaves; for during the first few years, when the stool-shoots show their most energetic growth, they make *at least* as high demands on the nutrients in the soil as they do later on when forming close

canopy. As coppice shoots flush at once in the first year, his assertions about the production of humus being interfered with have no value; for the young shoots protect the leaves from being blown about, and act in the direction of modifying the extremes of moisture and temperature, thus favouring the normal process of decomposition. That the enhanced increment of the standards decreases about the fifth year merely shows that the extra supplies of nutrient salts, afforded by the richer decomposition of humus after the periodical cutting back of the coppice, become exhausted after between four to five years. An additional objection to these experiments is that the observations were only made at the lower end of the stem in place of all along the bole; for experiments made by Weise on oak standards show that after each clearance of coppice there is an enhanced increment on the lower portion of the stem mostly, but that towards the end of the period of rotation of the coppice, after the twentieth year of undergrowth, the increment near the base of the stem decreases, whilst it becomes enhanced further up the bole, thus leading to a nearer approach to the cylindrical form and to higher general technical and financial value of the timber.

Under II. and III. the following results of experiments were quoted:—

Experiment.	Class of Forest.	No. of Stems per Acre.	Diameter of Average Stem.	Height of Average Stem.	Cubic Feet per Acre.
			Ins.	Ft.	
No. 1	64-year-old Scots pine forest without underwood.	·224	10·4	61·6	3,497
	64-year-old Scots pine forest with spruce underwood.	216	9·6	59·6	2,895
No. 2	42-year-old Scots pine forest without underwood.	494	6·1	44·0	2,050
	42-year-old Scots pine forest with spruce underwood.	453	5·1	36·6	1,090

These data were found to be far from conclusive, as the reliability of the former was materially shaken when the latter case was found to be a mixed forest of equal-aged pine and spruce (probably raised from sowing), where the struggle between the two species had been so keen as to affect the development of the pine, which only began to show good annual

increment after the spruce had been so interfered with in development as to necessitate their being thinned out, whilst in the portion shown as "with spruce underwood" the struggle was still going on, and the predominating pines suffered in consequence a partial loss of the annual increment they might otherwise have shown under normal conditions.

Measurements made by Zetsche in a 48-year-old Scots pine forest growing on sand, and underplanted with spruce 8 feet high, gave the following results:—

48-year-old Pine Forest.	Diameter of Average Stem.	Height of Average Stem.	Cubic Feet per Acre.	Total Basal Area of Stems.	Increment of Basal Area of Stems in the three years.			
	Ins.	Ft.		Sq. ft.		Sq. ft.		Sq. ft.
With spruce underwood	6·2	50·0	2,709	986·4	1875-77	=86·76	1878-80	= 82·08
Without underwood	6·2	50·3	2,809	1,015·2	Previous to clearance of underwood in 1877.	=93·96	After clearance of underwood in 1877.	=117·36

A subsequent revision of the experimental areas three years later (in 1883) confirmed the original data;* but as the areas only amounted to 0·225, 0·3, and 0·625 acres respectively, importance can hardly be attached to them as representing the natural state of affairs on a larger scale. As the mean average height of a plantation gives† a very sound means of judging of the quality of the soil, it appears evident that on the areas not underplanted the soil was somewhat better than on the other localities.

Observations made by Michaelis‡ in an oak forest with an 18-year-old undergrowth, chiefly of hornbeam and hazel in close canopy, showed that there was no practical difference between the annual increment on the standards there, and what was found on those in a different part of the same crop, which had been fenced off as a game-cover, and where the deer had browsed to such an extent on the shoots that there was practically no underwood. He noted, however, that the dead foliage was retained better, and was less liable to be blown away, on the part with undergrowth. That, in general, the productive power of soils can be retained without underplanting can hardly be safely argued from this one example, for in this particular case the relations of the soil as to moisture, exposure, &c., were not stated in detail.

* See "*Forstliche Blätter*," 1884, page 173.

† See Grebe's "*Betriebs-und Ertragsregelung*," 2nd edition, 1879, page 114.

‡ See "*Forstliche Blätter*," 1884, page 345.

Other observations were also made by him in 100 to 110-year-old pine forests, with beech undergrowth, and having a N.E. exposure; the following were the results he obtained :—

Scots Pine, 100 to 110 Years old.	Last 5 Years.	Last 6 to 10 Years.	Last 11 to 15 Years.
	Inches.	Inches.	Inches.
With undergrowth - -	0·296	0·292	0·400
Without undergrowth - -	0·816	0·356	0·400

The measurements were made by means of Pressler's "increment gauge," but it is not stated that all the spills of wood used for the countings were taken from that part of the stem which represented the true average annual increment of the stems. Few stems are cylindrical; hence, unless all the stems be operated on with the borer in similar proportion to the true increment, the data are not reliable. To have ascertained the true average breadth of the rings four spills should have been extracted from each stem at an equal height N., E., S., and W., and the mean of their measurements taken; yet this was not done. There would, however, have still been a serious flaw in the data, namely, that the measurements should not have taken place at breast-height only, but also in the upper portion of the stem. Michaelis made further observations in respect to a small 110-year-old oak plantation in the open, which was part of a grazing-ground till it was underplanted with silver fir in 1859, without being previously thinned or partially cleared. The measurements were made on sections taken at 3½ feet above the ground and at the top of the bole, just below the crown, the mean being used for purposes of comparison. The breadth of the annual rings was, in comparison with what it had been in the six years previous to underplanting,—

For the 1st six years after underplanting, 1·14 times as much.
„ 2nd „ „ „ 1·52 „
„ 3rd „ „ „ 1·13 „
„ 4th „ „ „ 1·10 „

These results he sought to explain away by the fact that at the time of underplanting the young plantations were closed to grazing or mowing, whilst the dead foliage of the oaks (and later on of the silver fir in addition) was retained for the formation of humus in place of being blown away by strong winds. He further ascribed the gradual diminution in increment throughout the third and fourth periods of six years after underplanting to the large claims that the undergrowth began to make on the nutrients available in the soil, and maintained

that, although it still remained greater than before underplanting was carried out, this simply showed that the effects of grazing and exposure to the action of winds were more injurious than the removal of a portion of the soil-nutriment by the silver fir underwood. That oaks will thrive better in the open when the herbage is not removed from the soil seems extremely probable; but there is nothing in the above record to show that the diminution in the increment is not due to the oaks beginning to form a somewhat closer canopy, and to demand thinning or partial clearing with a view to stimulating afresh their productive power.

This closes the brief for the opponents of underplanting, and the case may now be stated for those in favour of the method as a means of enhancing the productive capacity of the soil, and stimulating the standard trees to livelier growth and to the formation of broader annual rings of wood.

Arguments adduced by Advocates of Underplanting.

In 1886 Frömbling* published the results of measurements made on 160-year-old oaks growing on what was formerly grazing land, but which had been underplanted 35 years previously. In the case of three stems, which had been left close together without thinning, the breadth of the annual zones was at its minimum at the time of underplanting, but increased as the undergrowth formed canopy, and attained a breadth unequalled by any annual zones even during the previous 50 to 60 years, when the natural energy of growth of the trees was greatest. The other stems, which had been thinned or partially cleared, showed at first considerable increment in the breadth of the annual zones in consequence of the thinning out; this, however, fell off for three years, and then increased again when the underwood improved the soil by forming canopy and yielding humus by the decomposition of the dead leaves. The results of Frömbling's experiment were therefore diametrically at variance with those recorded by Michaelis, and were at the same time not open to any doubt as to possible differences in the quality and physical properties of the soil and situation.

More extensive observations were classified in the same journal by Runnebaum,† who recorded the measurements made on two areas under Scots pine, one of which was 120 years old and underplanted with beech, the other a 110-year-old crop without underwood, situated half a mile distant from the former. An examination of the soil showed only inconsiderable

* "*Zeitschrift für Forst-und Jagdwesen*," 1886, page 632.

† " " " 1885, pages 156 *et seq.*

differences as to its mineral composition, but the thick humus layer in the underplanted area had nearly double the quantity of mineral nutrients that were traceable in the thinner layer of mould in the forest without undergrowth. The outturn from the two equal sample areas was as follows, the price being 3·8*d.* per cubic foot in the former case and only 2·7*d.* in the latter :—

A.—120-year-old Scots pine underplanted with beech = 14,280 cubic feet pine + 343 cubic feet beech = 229*l.* 2*s.* + 27*l.* 13*s.* = 256*l.* 15*s.*

B.—110-year-old Scots pine without underwood = 13,370 cubic feet pine = 149*l.* 2*s.*

The first thing to strike one here is that, although (in consequence of heavier thinning of A at the time of underplanting) the annual average increment on A was only 119 cubic feet, whilst on B it amounted to 121½ cubic feet, yet there was a considerably higher price (+ 1·1*d.* cubic foot) derived from the pine growing over underwood, in consequence of its being straighter and smoother, more cylindrical in bole, and having annual rings *with proportionally larger development of the summer zone*, which, as is well known, is much more durable in conifers than the more porous spring zone. Here we have a confirmation of Prof. R. Hartig's theory that the underwood, by keeping the soil moist and cold in early spring, prevents the premature awakening of vegetation; in consequence of this the cambial activity is delayed for about a fortnight at least towards the warmer season of the year, when, in consequence of the greater warmth, the energy of the assimilative process and the formation of woody-fibrous tissue with thick cell-walls are materially enhanced. The greater freedom from branches must, to be fair and impartial, not be ascribed to any influence exerted by the undergrowth. It was probably due to an admixture of beech with the pine at the time of forming the forest; it had no connection with the beech underwood that sprung up spontaneously about the 60th or 70th year, as the natural clearance of all the lower branches must have been completed by that time. Measurements showed that after the spontaneous growth of the underwood the difference in diameter-increment became marked and continuous, as under :—

Diameters	At 50 years.	At 80 years.	At 100 years.
A - - -	8·4 inches	12·0 inches	13·6 inches.
B - - -	7·4 „	10·0 „	11·2 „
Difference -	1·0 inches	2·0 inches	2·4 inches.

One point in which the Munich experiments, immediately about to be recorded, are acknowledged to be unsatisfactory is that, although over 7,500 acres of high forest have been underplanted, forests without undergrowth, but otherwise absolutely similarly situated as to soil, situation, exposure, method of past treatment, &c., are wanting to form an absolutely accurate comparison. But in comparison with the above-mentioned experiments they have at any rate the advantage of having been made so as to take into account the increment in height; or in other words, that not merely the breadth of the annual rings, but also the superficial increment and the increment in cubic contents have been reckoned and chronicled,—and this is the only method which can yield truly reliable data.

Investigations made by the Forestry Branch of the Faculty of National Economy in Munich University, in order to ascertain the actual Effects of Underplanting.

First Series of Investigations.

The first series of experiments, or more correctly of investigations, was conducted in an 82-year-old oak forest (*Quercus pedunculata*) on deep, fresh, loamy sand, underplanted 28 years previously with beech, which had partly grown up into the crowns of the standards; the soil was covered with a dense layer of dead leaves and humus. The preliminary outturn from thinnings had not been recorded in any available form. A sample area showed the outturn per acre to be:—

Per Acre.	No. of Stems.	Basal Area.	Diameter of Average Stem.	Height of Average Stem.	Contents of Bole.	Contents of Branches.	Total Cubic Contents.
		Sq. ft.	Inches.	Feet.	Cub. ft.	Cub. ft.	Cub. ft.
Oak -	136	770	11·48	65	7,000	875	7,875
Beech -	2,960	273	1·48	28	—	—	—

The calculation of the cubic contents was made by means of two sample stems taken from each of the three girth classes formed by the standards. The oaks being 82 years old, and underplanted when 54 years old, the details on pages 12 and 13 were obtained by counting back, and by measurement of the annual rings included in the various periods of time.

No. of Sample Stem.	Total Height of Stem.	Height at which Crown began.	Height above Ground of the Sections examined.	Present Diameter (free of Bark) in Inches.	Periodical Diameter-Increment in Inches.					Periodical Superficial Increment in Square Feet.				
					Years before Underplanting.		Years after Underplanting.			Years before Underplanting.		Years after Underplanting.		
					20–10.	10–0.	0–10.	11–20.	21–30.	20–10.	10–0.	0–10.	11–20.	21–30.
1	Feet. 60·6	Feet. 26·6	Feet. 4·3	6·16	1·00	0·60	0·88	0·44	0·40	0·0374	0·0275	0·0473	0·0264	0·0288
			16·6	5·36	0·88	0·76	0·84	0·56	0·48	0·0242	0·0253	0·0363	0·0286	0·0275
			33·3	4·00	—	1·68	0·76	0·52	0·76	—	0·0231	0·0209	0·0176	0·0297
			39·6	3·20	—	—	0·76	0·64	0·72	—	—	0·0132	0·0165	0·0220
			46·2	1·88	—	—	—	0·52	0·80	—	—	—	0·0055	0·0143
					Periodic Increment in Cubic Feet -					0·4410	0·9275	1·2915	1·0115	1·2285
2	56·0	—	4·3	7·00	1·00	0·84	1·12	0·60	0·44	0·0385	0·0407	0·0660	0·0407	0·0330
			16·6	6·00	0·76	0·92	0·96	0·60	0·48	0·0231	0·0352	0·0473	0·0341	0·0319
			33·3	4·80	0·48	1·32	1·12	0·80	0·56	0·0044	0·0253	0·0363	0·0341	0·0275
			39·8	3·76	—	1·40	0·80	0·76	0·64	—	0·0143	0·0176	0·0231	0·0253
			6·2	2·68	—	—	0·80	0·76	0·64	—	—	—	0·0143	0·0165
					Periodic Increment in Cubic Feet -					0·7560	1·2950	1·8620	1·5085	1·3475
3	67·3	33·3	4·3	9·40	1·52	1·04	1·56	0·76	1·00	0·0770	0·0671	0·1023	0·0671	0·0968
			16·6	7·96	1·16	1·16	1·12	0·76	1·00	0·0440	0·0594	0·0704	0·0561	0·0814
			33·3	6·40	1·04	1·24	1·36	1·04	1·16	0·0154	0·0330	0·0550	0·0561	0·0737
			50·0	3·00	—	—	1·20	0·76	0·84	—	—	0·0121	0·0165	0·0242
					Periodic Increment in Cubic Feet -					1·6310	2·0615	3·0100	2·5310	3·6505

No. of Sample Stem.	Total Height of Stem.	Height at which Crown began.	Height above Ground of the Sections examined.	Present Diameter (free of Bark) in Inches.	Periodical Diameter-Increment in Inches.					Periodical Superficial Increment in Square Feet.				
					Years before Underplanting.		Years after Underplanting.			Years before Underplanting.		Years after Underplanting.		
					20–10.	10–0.	0–10.	11–20.	21–30.	20–10.	10–0.	0–10.	11–20.	21–30.
	Feet.	Feet.	Feet.											
4	68·6	—	4·3	9·40	0·76	0·88	0·80	0·52	0·40	0·0539	0·0693	0·0704	0·0495	0·0396
			16·6	8·44	0·72	0·80	0·76	0·56	0·40	0·0440	0·0550	0·0594	0·0473	0·0363
			33·3	6·00	0·92	0·96	0·64	0·48	0·40	0·0308	0·0429	0·0341	0·0286	0·0253
			50·0	3·60	—	1·20	0·88	0·64	0·44	—	0·0143	0·0209	0·0198	0·0165
			56·6	—	—	—	0·80	0·72	0·56	—	—	0·0110	0·0154	0·0121
					Periodic Increment in Cubic Feet -					1·7150	2·3135	2·3555	1·9495	1·5925
5	71·3	30·0	4·3	12·88	1·92	1·32	2·96	1·68	1·52	0·0990	0·0913	0·2728	0·1969	0·1981
			16·6	10·12	2·08	1·56	2·16	1·60	1·16	0·0638	0·0781	0·1518	0·1452	0·1199
			33·3	8·44	—	1·88	2·60	1·80	1·44	—	0·0396	0·1177	0·1243	0·1232
			50·0	4·60	—	—	1·64	1·40	1·44	—	—	0·0220	0·0418	0·0627
					Periodic Increment in Cubic Feet -					1·9285	2·6420	6·9860	6·5695	6·6325
6	75·0	—	4·3	13·48	1·52	1·36	2·36	2·04	1·84	0·0902	0·1012	0·2244	0·2420	0·2871
			16·6	11·44	1·52	1·28	2·16	1·68	1·56	0·0715	0·0792	0·1738	0·1694	0·1815
			33·3	8·08	1·04	1·68	1·68	1·60	1·56	0·0154	0·0495	0·0803	0·1045	0·1265
			50·0	4·56	—	—	0·96	1·12	1·24	—	—	0·0198	0·0363	0·0550
					Periodic Increment in Cubic Feet -					2·1385	3·0450	6·1720	7·0280	8·0535

Immediately before the underplanting took place a partial clearance or strong thinning was carried out, which, as is usual is such cases, of itself stimulated the trees to greater energy in the formation of broad annual rings, but in such a manner as to lower the form-factor, *i.e.*, to induce a tapering form of the bole, the rings being considerably broader near the base than further up near the top. After 10 years, however, when the underwood began to form close canopy, a not inconsiderable diminution of increment and of the breadth of the annual rings resulted near the base, which was succeeded in the following or third decade by a slight increase again in the case of four out of the six sample trees. But along with such diminished increment during the second decade, there was at the same time, in consequence of the underwood forming canopy, an unmistakable effort on the part of the standards to assimilate their mode of increment towards what it usually is when the trees stand in close canopy in place of being in free enjoyment of light and air, namely, a raising of the form-factor or improvement in the shape of the bole, due to the rings near the base of the stem being much narrower than those immediately under the crown and throughout the upper third of the bole, where indeed the breadth of the rings either remained almost constant or increased somewhat, as may be seen from an examination of the tabular record already given. It may be remarked, that if 10 or 20 years previously the crown had been deeper seated than it was at the time of making the experiments, the measurements would be valueless for the purposes of comparison, but from the appearance of the upper portion of the bole such had evidently not been the case.

These changes in the form-factor and improvements in the shape of the bole are more marked when one examines the data recorded as to the periodical superficial increment, for whilst, immediately after the strong thinning or partial clearance took place, at 33·3 feet it amounted to only 30 to 60 per cent. of that at breast-height, during the third decade it rose to 50 to 110 per cent. If the increment at breast-height alone be taken into consideration, one might occasionally come to results diametrically opposed to those yielded by a more accurate computation of the actual increment; *e.g.*, sample stem No. 3 shows diminution of increment at breast-height, whilst the total increment throughout the stem in the last decade is greater than immediately after the partial clearance in the proportion of 3·6505 cubic feet to 1·6310 cubic feet. This improvement in the form-factor, inconsiderable though it often may be, is due to diminished

assimilation of nutrients and production of constructive matter in the crown of the trees, in consequence of which smaller quantities of assimilated nourishment are conducted back to the lower portions of the stem and to the root-system; whilst at the same time the mechanical hindrance offered by the underwood to insolation, and the cold shade cast over the soil, militate against the extraction of such large supplies of nutrients being drawn from the soil as would be the case if the latter were warmed by insolation and the root-system were stimulated by a greater degree of warmth. The diminished productive capacity of the crowns of the smaller and average classes of standards is probably mainly due to the free enjoyment of light and air being interfered with as they expand, whilst in the larger girth classes it may be ascribable to the undergrowth beginning to mingle with the lower portion of the leaf-canopy of the standards, and thus interfering with the assimilative power of the lower foliage.

Second Series of Investigations.

That the above-suggested probable main causes are justified may be deduced from the following data obtained from two 105-year-old oak standards that, after having for at least 20 to 30 years stood with their crowns in the full enjoyment of light and air, were underplanted with beech, now about 40 years old, which, growing in close canopy, was already partially forcing its way up into the lower portions of the crowns of the oaks. The forest occupied a high situation and was unprotected towards west and south, where it bordered on arable land; the quality of soil was below the average, and the oak standards were scattered about singly or in small groups throughout the beech undergrowth. Apart from the influence ascribable to the slightly inferior quality of the soil, the boles of the oaks were short, owing to their formerly having had a large amount of growing-space, due probably to wide planting originally; and whereas records showed that the soil had formerly been overgrown with whortleberries, it now had a thick covering of fallen leaves and a good layer of humus. The underwood was formed during 1843 to 1847 by means of sowing beech-nuts; this was carried out immediately after a thinning, and was succeeded in 1853 to 1856 by a clearance of all diseased stems. The measurements made showed that about eight years after the undergrowth was formed the rate of increment sank considerably, after having increased (owing to the thinning

out) at the time of its formation; that the effects of these two heavy thinnings or partial clearances continued for about two decades to reduce the form-factor by causing larger annual increment near the butt-end than at the top of the bole; that during the third and fourth decades after the formation of the underwood the basal increment was lower in No. 1 and the same as previously in No. 2, whilst in both cases the increment in the upper portions of the trees was somewhat greater; finally, that during the fourth decade the superficial increment of the various sections, and the total increment in cubic contents, were practically about the double of what they were throughout the decade previous to the underplanting, which emphatically disposes of the argument that the growth of the standards is injuriously affected by the underwood consuming a large share of the nutrients contained in the soil. That the gradual improvement in the form-factor or shape of the bole was due to the beech underwood interfering with the activity of the most deeply-seated foliage is hardly open to reasonable doubt. The detailed measurements were as follows (see page 17), the oaks being 105 years old at the time of the investigations, and having been underplanted at 65 years of age :—

No. of Sample Stem.	Total Height of Stem.	Height at which Crown began.	Height above Ground of the Sections examined.	Present Diameter (free of Bark) in Inches.	Periodical Diameter-Increment in Inches.						Periodical Superficial Increment in Square Feet.					
					Years before Underplanting.		Years after Underplanting.				Years before Underplanting.		Years after Underplanting.			
					20–10	10–0.	0–10.	11–20.	21–30.	31–40.	20–10.	10–0.	0–10.	11–20.	21–30.	31–40.
1	Feet. 59·6	Feet. 31·3	Feet. 4·0	13·44	1·48	1·12	1·68	2·28	1·40	1·20	0·0858	0·0506	0·1408	0·2387	0·1738	0·1672
			17·3	8·80	1·44	0·96	1·28	1·24	1·00	0·76	0·0440	0·0418	0·0715	0·0858	0·0814	0·0693
			37·3	6·32	—	1·04	1·12	1·08	1·28	1·12	—	0·0165	0·0275	0·0358	0·0388	0·0693
					Periodical Increment in Cubic Feet -						—	3·7485	5·1764	5·1870	5·2010	6·1880
2	60·6	25·3	4·0	13·08	1·88	0·96	1·36	1·52	1·36	1·20	0·1166	0·0748	0·1221	0·1595	0·1650	0·1617
			14·0	11·12	2·08	1·16	1·36	1·32	1·12	0·96	0·0935	0·0726	0·1034	0·1188	0·1166	0·1166
			24·0	9·40	1·88	1·36	1·20	1·20	1·24	1·20	0·0441	0·0572	0·0661	0·0825	0 1012	0·1144
			38·0	7·60	—	—	1·52	1·32	1·40	1·36	—	—	0·0441	0·0594	0·0836	0·1023
			44·0	3·12	—	—	—	0·80	0·88	0·84	—	—	—	0·0088	0·0176	0·0242
					Periodical Increment in Cubic Feet -						—	2·1350	3·1710	3·9725	4·5150	4·8305

Third Series of Investigations.

A third experimental area was again selected in the Spessart Forest, in an 88-year-old oak wood raised from seed on old arable land, and the past history of which was accurately traceable. Throughout the earlier periods of development its growth was good, but about the fortieth year the soil became thickly overgrown with whortleberry, the increment diminished considerably, and the crop had anything but a promising appearance. Without any previous thinning, beech-nuts were sown out in 1840 for the purpose of forming an underwood, but in 1844 to 1847 a strong thinning or partial clearance took place along with underplanting. Light thinnings were made in 1852 to 1854, 1859, and 1873, and in 1887 a further thinning out of about 80 stems per acre took place, leaving from 280 to 320, or in round numbers about 300, per acre, which at the time of the experiment formed close canopy. The effect of the first thinning was only so slight an increase of energy in growth as hardly to make itself noticeable in the breadth of the annual rings, or to affect the shape and form-factor; but slight as it was, it remained traceable during the third and fourth decades in the predominant and dominant stems, whilst the weaker individuals that fell into the subdominant class showed gradual diminution of increment in consequence of their crowns becoming suppressed. In this case the detailed measurements were as follows (see page 19), the oak standards being 88 years old at the time of the investigations, and the thinning out and underplanting with beech having taken place when they were 46 years of age:—

No. of Sample Stem.	Total Height of Stem.	Height at which Crown began.	Height above Ground of the Sections examined.	Present Diameter (free of Bark) in Inches.	Periodical Diameter-Increment in Inches.					Periodical Superficial Increment in Square Feet.				
					Years before Under-planting.	Years after Underplanting.				Years before Under-planting.	Years after Underplanting.			
					10–0.	0–10.	11–20.	21–30.	31–40.	10–0.	0–10.	11–20.	21–30.	31–40.
1	Feet. 67·3	Feet. 43·3	Feet. 4·0	7·44	0·72	0·96	0·72	0·64	0·52	0·0330	0·0528	0·0462	0·0451	0·0341
			14·0	6·72	0·84	0·96	0·72	0·56	0·48	0·0308	0·0462	0·0407	0·0352	0·0330
			24·0	6·20	1·16	1·16	0·80	0·64	0·48	0·0308	0·0462	0·0396	0·0363	0·0308
			34·0	5·16	1·16	1·40	0·96	0·76	0·60	0·0099	0·0297	0·0330	0·0341	0·0308
			40·6	4·08	—	—	1·08	0·92	0·68	—	—	0·0209	0·0286	0·0264
					Periodical Increment in Cubic Feet -					0·8295	1·6940	1·5575	1·6660	1·5365
2	71·6	46·6	4·0	9·40	1·04	1·04	1·20	1·32	1·24	0·0253	0·0319	0·0473	0·0748	0·0704
			14·0	8·32	0·96	1·00	1·16	1·20	1·16	0·0396	0·0462	0·0583	0·0693	0·0715
			24·0	7·92	1·44	1·16	1·12	1·24	1·12	0·0352	0·0484	0·0605	0·0835	0·0891
			30·6	7·12	1·56	1·40	1·24	1·16	1·00	0·0462	0·0473	0·0682	0·0858	0·0913
			37·3	6·52	—	1·60	1·32	1·48	1·08	—	0·0572	0·0814	0·1067	0·1177
					Periodical Increment in Cubic Feet -					1·3055	1·8935	2·7160	3·9480	4·5135
3	74·0	53·3	4·0	9·56	1·36	1·16	1·12	0·96	0·88	0·0693	0·0759	0·0869	0·0847	0·0869
			14·0	8·16	1·36	1·12	0·96	0·92	0·80	0·0539	0·0550	0·0627	0·0682	0·0671
			20·6	7·80	1·96	1·48	1·04	0·88	0·88	0·0539	0·0682	0·0616	0·0616	0·0704
			27·3	7·20	—	2·12	1·16	0·88	0·92	—	0·0726	0·0605	0·0561	0·0660
			34·0	6·88	—	—	1·48	1·12	1·00	—	—	0·0638	0·0649	0·0693
			40·6	6·00	—	—	1·96	1·64	1·28	—	—	0·0451	0·0682	0·0748
					Periodical Increment in Cubic Feet -					1·5890	2·2855	2·8175	3·1780	3·8850

As regards increment in height, the analyses of the sample stems in the above experiments showed that this diminished after the strong thinning or partial clearance, but eventually regained its former level, and in some cases exceeded what it had previously been. So far as any deduction may be allowable from the comparatively small number of sample trees, it seems to be the case that after each thinning the diminution of increment in height was due to the tendency of the oak to expand laterally and internally to the prejudice of the vertical energy, which, however, regained its ascendancy when once the crowns again began to form close canopy.

Such are a few of the most important of the data obtained by the experiments of the Forest Branch of Munich University, conducted by Dr. Kast, lecturer on Forestry, who has kindly permitted me to make free use of his investigations on the subject * As previously stated, although practically conclusive, they are still open to the scientific or academic objection that they fail to yield comparisons with actual measurements made on forest crops of absolutely similar nature growing on soils and situations also absolutely similar in quality and physical and climatic conditions, but differing only in never having been underplanted or never having had any artificial underwood formed below them.

The practical conclusions which it appears justifiable to deduce from these three series of carefully-made measurements may now be stated.

Practical Conclusions deducible from the Munich Investigations.

When forests of light-demanding species are underplanted, and the underwood begins to form close canopy, the effect is to produce a simultaneous diminution of the breadth of the annual rings in the basal portion of the stem, but to a much less extent, or not at all, in the upper portions of the bole, and without always diminishing the total annual increment on the tree. Wherever any considerable diminution of annual increment takes place in individual stems, it is probably due to re-formation of close canopy after thinning or partial clearance, in consequence of the full development and assimilative activity of the coronal foliage being interfered with.

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* "*Ueber den Unterbau und seine wirthschaftliche Bedeutung*," 1889.

Runnebaum's experiments confirmed, so far as the Scots pine is concerned, Professor R. Hartig's theory that better and heavier timber is produced when there is underwood than when the soil is unprotected; but, as already explained, the other experiments could not yield final or academically satisfactory results. So much could, however, in a general way be deduced that, though favourable in other physical respects, undergrowth does not, as was generally accepted, directly stimulate to greater annual increment, owing to its withdrawing a portion of the nutrient salts from the soil. But the quantity of nutrients thus tapped is very inconsiderable, and does not at all justify the outcry of the opponents of underplanting, more especially on the better classes of soil. Their argument that, when thinnings or partial clearances are made, the spontaneous growth of grasses and weeds restores annually to the soil the nutrients taken from it, overlooks the fact proved by Vonhausen* that a soil covering of grass withdraws about four to five times as many nutrient salts as are utilised by beech undergrowth, and that as the humus formed by such soil-covering is almost entirely consumed by the superficial growth of weeds, the total of nutrients requisite for the maintenance of the annual development of the soil-covering is practically withdrawn from the possibility of being utilised by the timber crop,—whilst in comparison with that the quantity annually withdrawn by the underwood is inconsiderable, or at any rate so very much smaller as hardly to be practically taken in account, in the case of soils above the average, so far as concerns the further development of the standards. For the poorer classes of soils, however, it may possibly make its influence felt when the underwood is dense; but this will be more than counterbalanced by the larger increment which will follow thinnings or partial clearances in such cases in comparison with similar measures of tending carried out on tracts unprovided with undergrowth, in consequence of the greater supplies of dead foliage available for decomposition under the stronger action of light, air, and warmth. That the underwood can under certain circumstances make higher demands on the nutritive capacity of the soil than are preferred by the standards is of course self-evident, for it would be useless to attempt to underplant pine woods with beech on the poorer classes of sandy soil.

Next to the influence exerted on the total annual increment comes the question of the quality of the timber produced. This

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* "*Allgemeine Forst-und Jagd-Zeitung*," 1872, page 1.

is mainly influenced by a high form-factor, by freedom from branches and knots, by a large proportion of heartwood to sapwood, and finally by the height of the specific gravity, as for any mature samples of one and the same species of timber (in an equal stage of seasoning) it is incontrovertible that the heaviest is the most durable.*

The specific weight of any kind of timber *per se* is directly dependent on the proportion which the hard, dense, heavy zone formed during the hot weeks of summer bears to the lighter porous spring zone in the annual ring. The longer that activity of vegetation is delayed in spring, and the more it is forced into the warmer weather of summer, the denser, heavier, and technically preferable will be the timber produced; and as the practical effect of the underwood is to maintain the soil cool in spring by reason of the mechanical hindrance it offers to insolation and consequent direct heating of the ground, it delays, with favourable results for the quality of the timber to be formed, the annual commencement of vegetation for at least a fortnight. For timber crops treated under the method of partial clearance this is of very great importance, as otherwise the approximate isolation of the standards would directly lead to the production of a poorer quality (although larger quantity) of timber than previous to the thinning out or partial clearance.

That the underwood is also of practical utility in clearing the lower branches from the stem hardly needs any demonstration. As it gradually grows up into the lower portions of the crowns it not only suppresses the foliage of the lower branches that can still maintain a struggling existence under the partial shade of the crowns, but otherwise aids mechanically in breaking off dead branches; and by maintaining the soil cool and moist it also assists materially in hastening their decomposition. This function of the undergrowth is, however, not of the first importance; for by the time it grows up into the lower crowns the natural thinning of the lower branches in normally developed forests should practically have already been completed.

From the experiments it seems warrantable to conclude that the older the underwood and the higher up it reaches into the lower portion of the crown, the greater is its influence in improving the form-factor and the consequent utility and technical and financial value of the stem; but these advantages are counterbalanced by a general reduction in the

* See Gayer's "*Forstbenutzung*," 7th edition, 1888, page 66.

annual productive capacity of the tree if the undergrowth be allowed to grow up high enough to interfere so far with the normal development of the crown of the standard trees as to cause partial suppression.

Concerning the natural laws which govern the quantitative relation of heartwood to sapwood practically nothing is yet known, though Runnebaum and others have found that pine standards with beech underwood show a larger proportion of heartwood than the trees grown in pure forests of pine. As, however, the same holds good for mixed forests of pine, spruce, beech, &c., there can be no justification for assuming that underplanting specially favours an increased production of heartwood or lessens the period of semi-activity which the older sapwood has to live through before attaining its highest maturity as duramen.

But the greatest ultimate importance of the undergrowth is undoubtedly to be looked for in the influence which it exerts on the soil, not only physically and immediately, but also throughout long subsequent periods, in consequence of the humus formed by the fallen leaves modifying all the physical properties of any given ordinary soil, and increasing and returning to it in a convenient, easily assimilated, soluble form the previously consumed supplies of nutrient salts. These physical and immediate influences of the undergrowth are everywhere visible in the maintenance of the soil against insolation, in the preservation of the soil-moisture, in the annual fall of leaves and its retention against being blown away, in fixation of the soil on hillsides, and in the slight but gradual assistance afforded by the humus towards effecting the further decomposition of the mineral layers and a consequent enrichment of the soil.

It is true that enormous quantities of moisture are transpired through beech leaves, even when forming undergrowth and in the enjoyment of but a limited supply of sunshine and light, and also that during rainfall a large percentage of the precipitations is caught up by the leaves and branches without reaching the ground; but the importance attached thereto by the opponents of underplanting seems hardly justifiable in the face of the fact that, without a layer of humus or moss, the surface-soil is little able to hold the moisture received as rainfall, whilst the evaporation caused by insolation and by the free play of winds must also be factors of enormous potentiality. As a matter of practical result, Ramann found* that, in the areas

* "*Zeitschrift für Forst-und Jagdwesen*," 1885, page 172.

experimented on by Runnebaum, from the middle of May till the end of August there was always more moisture immediately underlying the humus in the pine forest underplanted with beech than in the pure pine woods; but below that down to a depth of 2 ft. the soil was moister in the former for the first half of the time, and drier throughout the second half, whilst the layers at about 28 to 32 inches below the surface were always moister in the pure pine woods. The explanation he gave was that in pure pine forests the spontaneous growth of grass, heather, &c., exhausted the superficial supplies of moisture to a greater extent than the beech underwood, whilst the middle layer at about 20 to 24 inches had to furnish supplies to both beech and pine, and that in the pure forest the deeper layer received larger supplies of moisture from the surface after the grasses had completed their development than could be the case where the beech undergrowth covered the soil. Wollny also obtained similar results in independent experiments conducted in Austria, which may briefly be summarised as follows* :—

1. That the quantity of moisture under a soil-covering of living plants is always less during the period of active vegetation than at a similar depth on naked soil, in consequence of transpiration through the foliage, and that this influence is traceable even down to the lower layers.
2. That the quantity found is less, the denser the plants stand, without being inversely proportional to the density.
3. That a soil-covering of dead growth or leaves, up to two inches in thickness, permits of better percolation of moisture from the surface-soil towards the lower layers than the naked soil seems to do.

These investigations, taken in conjunction with Ebermayer's conclusion† that forest soil was moister than similar soil in the open only in the upper layers, but was always drier in those pervaded by the roots, point to the correctness of Ramann's deductions.

The effects of underplanting with beech, hornbeam, or silver fir, which have all got a somewhat similar heart-shaped and moderately-reaching root-system, will be practically about the same; but in the case of the shallow-rooting spruce some modifications of the effects should be noticeable.

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* Wollny's "*Forschungen auf dem Gebiete der Agricultur-Physik*," Vol. X., page 261.

† "*Die Physicalischen Einwirkungen des Waldes auf Luft und Boden*," 1873, pp. 218–232.

In woods underplanted with spruce the upper layer of soil will still not contain more moisture than in pure forests, as the shallow root-system will draw its chief supplies of water from the soil lying within about 1 to 1½ feet from the surface, whilst below that the quantity of moisture should be about the same, at any rate during the first half of the annual period of vegetation. Owing, however, to the great density of spruce undergrowth, a considerable proportion of the atmospheric precipitations will be intercepted without ever having any chance of percolating through to the lower soil, so that the deeper layers may in general have less moisture than is to be found in similar soils bearing pure forests without underwood. As the foliage of spruce and silver fir is retained throughout the whole year, this not only intercepts a larger proportion of the precipitations during the non-active period, but also requires water for transpiration through the needles; hence, throughout the period during which broad-leaved deciduous undergrowth remains defoliated, the soil under the latter should, *cet. par.*, show larger supplies of moisture than soils bearing coniferous underwood.

It stands to reason that a dense undergrowth throughout a whole forest will withdraw larger supplies of moisture from the soil than one forming merely a loose canopy; and in consequence of this, it may perhaps be found to be of the greatest practical advantage to underplant in groups and patches wherever there is no good soil-covering of dead foliage or moss, as such partial underplanting will probably exert a sufficient influence in protecting the rest of the soil from the bad results of insolation, and in particular from the drying-up effects of winds. And although the former idea, that soils with a covering of underwood were always moister than those without, has not on investigation shown itself to be unconditionally correct, yet the importance of the retention of the fallen leaves, and the prevention of their being blown away by the wind, has in no way been overrated. But to serve this latter purpose something more is necessary than a thickly-foliaged outer fringe or belt along the edges of the forest, unless the compartments are very small and the soil is practically level, though even then the object in view is more safely attained by means of underwood.

It is a practical fact, hardly necessary of any elaborate demonstration or proof, that the more valuable assortments of oak and pine cannot be profitably* produced merely by strong

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* See essay "*On the Selection of Species of Trees for Woodland Crops, and on the Choice of the Method of Treatment*, &c.," page 27.

thinnings out and prolongation of the period of rotation, as for their full normal development they demand a larger growing-space for the expansion of their crowns than can be given in pure forests without entailing serious interruption of the canopy, and consequent exposure of the soil to the deteriorating effects of insolation and exhausting winds. Strong thinnings or partial clearance about the 60th to 80th year for oak, or the 30th to 40th year for pine, when (according to the soil and situation) their main growth in height has culminated, and simultaneous underplanting or sowing of the species of shade-bearing trees best adapted for the particular soil, are the only advisable, rational, and remunerative method of stimulating the standards to further active production of good annual increment. It is not denied that the increment will be stimulated by the mere enlargement of the growing-space of the individual trees; but it is maintained, and in the foregoing seems to have been satisfactorily proved, that such enhanced increment on the individual trees must be dearly purchased at the cost of the subsequent deterioration of the productive capacity of the soil and diminution of the annual increment per acre, not to mention the higher technical and monetary value of the timber when the boles are not much inclined to taper.

Up to the present the underwood has been considered solely with reference to its influence on the later growth and development of the light-demanding standards; but it is also worthy of some special consideration on its own account. Even though all the standards be healthy and of normal appearance at the time of thinning and underplanting, further clearance to a greater or less extent is usually necessary before the utilisation of the whole crop is contemplated; and when there is no underwood, this simply means that on such places the soil is either not utilised at all, or not utilised to its full advantage. Where, however, underwood exists, it can grow up in the blanks to form part of the crop to be finally harvested. In such cases beech and hornbeam will yield less remunerative results than spruce or silver fir; for although, in general, under the shade of the standards, the latter will hardly develop into the better-paid assortments of timber, yet, thanks to the limited growing-space that suffices for the normal development of their crowns, they can of themselves—apart from their beneficial and remunerative influence on the main crop—often yield a good return for the initial costs of underplanting, and a moderate rental for the sub-tenancy of the soil they occupy.

With the maturity of the standard crop the underwood has done its duty, and can either be cleared away for the purpose of reproducing the standards naturally from the seed shed, or be retained for some time longer and treated as high forest, at any rate in groups or patches that show good development and give promise of a fair outturn in timber. Generally throughout Britain, however, where financial principles must mainly guide the landed proprietors in forest matters, and where there is a comparatively small and not very remunerative market for firewood, the clearance of the underwood will precede the reproduction and utilisation of the standard crop. For the underplanting of the deciduous, light-demanding species of our forest trees—oak, ash, maple, and sycamore—beech, and on moister localities hornbeam yield better results on the whole than spruce or silver fir, as they accommodate themselves more to the natural development and habit of growth of the standards. For larch and pine woods, on the other hand, spruce, or on the better classes of soil, and in mild, sunny localities, Douglas, Nordmann's, or silver fir, naturally conform better to the habit of growth of these standard species, though underplanting with beech or hornbeam is still more decidedly advisable wherever the conditions of soil and situation render it possible, owing to the very advantageous influence the broad-leaved species exert in minimising the effects of damage done by insect enemies. In this latter respect their influence is somewhat similar to that of mixed forests, but less strongly marked; it becomes the greater, the more the underwood is able to extend upwards towards the lower portions of the crowns of the standards, and thus form, as it were, an integral portion of the leaf canopy.

But the choice of the species to be used for underplanting is dependent for the most part on considerations as to soil and situation. Without referring to special cases like the growth of alder as coppice under essentially light-demanding species on moist, fertile, rather marshy soils, it is practically limited to the four shade-bearing species, beech, hornbeam, spruce, and silver fir. Of these spruce is certainly most moderate in its demands, and it has another recommendation in deriving its supplies of nutrients chiefly from the upper layer of soil not tapped by the deeper-rooted species, oak and pine; the other three species not only make greater demands on the mineral strength of the soil, but also through their deeper root-systems tend to come more in competition with the standards with regard to the withdrawal of the nutrients held in solution in the middle layers of the soil. Speaking generally, however, broad-leaved species certainly

deserve the preference if underplanting takes place simply with a view to the protection and improvement of the soil; whilst a mixture of conifers and broad-leaved species recommends itself wherever it is desired to obtain a crop of fairly marketable stems along with the mature standards. That the greatest improvement in the soil takes place when beech is the underwood is incontestible; but in consequence of its comparatively high demands on potash and phosphoric acid it cannot be used on the poorer classes of soil, and when growing under oak in damp localities exposed to late frosts it suffers considerably more than hornbeam in consequence of its flush of spring leaves coming about a fortnight earlier than those of the standards. Where a choice remains open only between spruce and silver fir, or for admixture of these with the beech or hornbeam, the silver fir in general deserves the preference, notwithstanding its deeper root-system and greater claims on mineral strength of soil, for it bears shade better on the whole, is more favourable to the formation of humus, and does not close the soil so much to the circulation of air, to the reception of atmospheric precipitations, and to the percolation of the surface-moisture down through the upper layers towards the subsoil. For the underplanting of oaks, spruce is not to be recommended, as it is apt to interfere greatly with the functions of the crown later on; for oak-soils the beech, and on moist parts the hornbeam, should form the bulk of the underwood, with silver fir mixed in patches where there seems any chance of its ultimately being likely to develop into good marketable dimensions. The underplanting of oak with spruce has been practically condemned by most of the eminent sylviculturists in Germany. There are several reasons for this, one of them being that, by intercepting and utilising for its own benefit a large proportion of the atmospheric precipitations, it induces "*stag-headedness*," owing to insufficient supplies of moisture reaching the lower layers of soil; but this disease is often also due to injudicious thinning or partial clearance on soils below the average in quality, and naturally somewhat deficient in moisture, when the evil is, of course, aggravated by the choice of spruce as underwood. Although Weymouth and black or Austrian pines bear more shade than Scots pine, their capacity in this respect is hardly great enough to admit of their being utilised as underwood; much better results are promised by the Douglas and Nordmann's firs, which closely resemble the silver fir in many respects.

The opinion was formerly general among sylviculturists that the full advantages of underplanting were only obtainable when the whole area was under cover; but although the fullest returns

from dead foliage can undoubtedly be thus secured, other points of view seem to indicate that partial underplanting can also attain desirable results, whilst at the same time obviating certain drawbacks relative to the too extensive demands of a full, dense undergrowth on the moisture of the soil. For such partial underplanting in patches or small groups the advantages claimed are that by occupying only a portion of the soil it competes to a much less degree with the standards in making demands on nutrients, a matter which is of the greater importance, the poorer the soil is; that whilst withdrawing smaller supplies of moisture from the ground it permits a larger proportion of the atmospheric precipitations to reach the soil directly, and at the same time affords the necessary protection, both mechanically and otherwise indirectly, against the rapid evaporation caused by sun and wind; that it stimulates the decomposition of the fallen leaves and needles by favouring the freer play of the necessary factors, warmth, moisture, and atmospheric oxygen, and prevents the accumulation of an unproductive, undecomposed layer of foliage, such as may often be noticed in the case of dense underwood of spruce especially; that it offers the best means of forming mixed undergrowth on all places where soil, situation, or standards require different species from the rest of the area, or any special treatment of the underwood chosen; and that, finally, it costs only a proportional amount of the outlay that the planting up or sowing of the whole area would entail.

Recapitulation.

To recapitulate briefly the results of the Munich experiments, it has not yet been shown that the undergrowth exerts any direct and immediate influence on the increment of the light-demanding standards, but it undoubtedly does improve the shape of the bole, and consequently enhances its financial and technical value, and also improves the quality of the timber, at any rate in the case of the light-demanding conifers. Again, by increasing the quantity of fallen leaves and needles, and preventing them from being blown away by winds, it essentially favours the production and direct increase of humus, so that it materially affects the physical properties of the soil and stimulates its productive capacity.

Oak, larch, and pine are the species extensively grown in pure forest which stand most in need of underplanting when once they have completed their main growth in height and

begin to make larger demands on growing-space; the other light-demanding species, like ash, elm, maple, and sycamore, should less frequently be grown in pure forest than simply as patches in mixed woods, where a ruling species, preferably the beech, protects the soil against deterioration. Shade-bearing species require no undergrowth. Unless maintained in close canopy they tend to branch development and consequent reduction of the form-factor of the bole, with diminished monetary and technical value; moreover, it is only on the very best qualities of soil that beech, spruce, or silver fir can thrive for any length of time under the dense shade of parent standards forming anything like a full canopy.

Whether the underwood should be formed by sowing or planting depends in each case on local circumstances. Sowing is in the majority of cases much cheaper, but it takes longer to attain the object in view. Planting can be easily carried out, wherever practicable, with seedlings from neighbouring woods or with two to three-year-old seedlings or transplants from temporary nurseries, and should not amount to more than about 15*s.* per acre if put out from $3\frac{1}{2} \times 3\frac{1}{2}$ to 4×4 feet apart by means of notching. But even should the costs of underplanting be higher locally, the advantages of the method are still cheaply obtained where the intention is to produce the most satisfactory monetary returns from pure forests of oak, larch, or pine that are unable of themselves to protect the soil against deterioration, but which it is not desirable to clear away yet for the formation of other crops of timber. Many an oak grove in England, and many a larch and pine tract in Scotland, would yield far more satisfactory returns from every point of view—financially, sylviculturally, technically, and æsthetically—if due measures were taken for the protection and improvement of the productive capacity of the soil by means of underplanting after thinning or slight clearance, and treatment thereafter in accordance with the rational principles of the science of forestry.

highest point, 1,500 metres above sea-level from which the most extensive panorama may be enjoyed, as it were touching Florence with the one hand and Siena with the other, the whole of Etruria at one's feet; a stroll through the woods to the "Lago," the Eastern limit of the State forests, and to the "Bocca del Lupo" the western limit; then, further away and outside the limits of the State domain to Camaldoli and l'Alvernia, into the Mugello and the Casentino, to the castles of Vincigliata and of S. Mezzana di Panciatichi; and many more, too numerous to relate.

For the shikari again, Vallombrosa has its charms. Partridges, quails, hares, wood-pigeons, doves, used to abound, as well as squirrels, though a shooting permit from the Minister of Agriculture is necessary, except in the case of squirrels. The slaughter of these animals is actually encouraged. They cause much damage to the pine trees, and consequently a reward of 20 centimes per squirrel-tail may be obtained from the Department of Agriculture, a practice which also exists in many Scottish forests. Bears, it is to be feared, have quite disappeared, though these appear to have existed in past ages. On the walls of the Monastery, where many of the miracles performed by the San Giovanni, the founder, are inscribed may be read the following:—"Il Santo ordina me converso di andare ad ammazzare un orso in una grotta e il converso va e l'orso exe dalla grotta per farsi ammazzare." Perhaps modern bears, even if they existed at Vallombrosa, would not be so amenable to reason.

In the Monastery itself a bright new visitor's book is still kept, and though all the scribblings bear witness to the charms of the place, it is necessary to turn to the pages of a more ancient and long disused volume to find anything worth transcribing. A French visitor, breaking into poetry, thus addresses his invocation to Vallombrosa:—

"De ces monts surcilleux qu' habitent les orages,
Que l'etranger visite ainsi que les nuages,
Qu'il est doux de prier avec un doux amour,
De rever au bonheur de l'éternal sèjour.
D'ici je crois ouïr des paroles étranges:
Est-ce la voix des Saints, ou les concerts des Anges?
Ici je comprends mieux du ciel l'immensitè,
Et voudrais ni élaucer vers l'immortalité."

Whilst yet another Frenchman wrote:—

"L'oubli, le calme de l'esprit, la paix du cœur sont possibles dans une sembable retraite. Les grands spectacles de la nature doivent contribuer á rendre l'homme meilleur. Demeure delicieuse de Vallombreuse, Adieu! Sèjour des anges, oú y domine le beau et le sublime, oú jouissant de la vraie beauté de la nature on s'approche á son Dieu: Adieu!"

A. C.

The Herikalgudda Forest. By N. Narayen Rao, Forest Ranger, Hassan.

This hill forest is situated in the Arsikere taluq of the Hassan District, Mysore. It derives its name from Herikal, a huge rock, measuring 40 feet in height by 360 feet in girth. The group of hills measures about 58,800 acres, or 92 square miles in extent, and possesses a varied flora. The highest peak is Kare-kulloo, 4,300 feet above sea level. The circumference of the base of the hill is 21¼ miles, and a cleared line, 22 yards wide, separates it from private holdings and other district or unreserved forests. On one of these hills is situated a temple of Sri Venketramananaswamy, a shrine of great antiquity. It is known as Malekal Tirupathi. A flight of 1,750 steps leads to the top, and the ascent of these steps is supposed to be an efficacious substitute for a pilgrimage to the famous Tirupathi shrine in North-Arcot. A Rathotchavam or car festival is held at Tirupathi at the foot of the hill in Ashada, in July each year, and about 3,000 to 4,000 people attend.

There are some temples, partly in ruins, and other monuments which indicate the existence of a city on the Herikal hills in former times; and it is understood that during his wars with the Mahrattas Hyder Ali removed his people to form a city at Nagpuri on the Herikal hills. The circumference of the plain on the hill is 11¼ miles.

The hills are of primitive formation, chiefly granite, and this is abundant, and is fit to be quarried for building purposes by the simple application of heat. The entire group is composed of several rocks or rugged hills, each of which has a name given to it, which is taken from some romantic incident of its own. There are 65 hillocks of the kind.

Around the hill are several villages, more or less thickly populated; and each village has a pass of its own to go up the hill and join the common Nagpuri-Bylu (plain), wherein is situated the Sri Shankeriswara's temple, the common god of all persons of the Shivaite sect, residing in the villages round the hill. All these passes are ascended by very steep paths, only practicable for pedestrians.

It was years before this hill forest could be brought under reservation and the management of the Forest Department. The question of reserving it was first mooted about the year 1872, when Colonel Hill was Deputy Commissioner of Hassan, and after much opposition on the part of the ryots and trouble in the acquisition of two private rights in the forest, it was finally reserved in the year 1882 after a period of 10 years had elapsed in a struggle with a heavy file of correspondence. The difficulty lay, as usual, in the fact of the ryots not appreciating the value of the conservancy of the forests.

It is very probable that the hill may have been well wooded during the time of the poligars, as on many of the hills traces are to be seen of forests cut down long ago, and this statement is confirmed by the existence of fine trees in inaccessible places, and of kinds of trees which are not generally cut by ryots for timber, &c. Between the time of the poligars and that of the conservation of the forest by the State, cultivators appear to have cut down whatever they required for agricultural implements, &c, regardless of the destruction caused to young trees and saplings. No one ever thought of planting new trees to replace those that had been felled, and so, as population increased and agriculture spread, the remaining trees rapidly disappeared. The denudation of trees from which the taluq suffers has probably much to do with the prevailing drought, there being scarcely any vegetation to arrest the passage of the monsoon clouds which float onwards without depositing their valuable contents.

Since the Forest has been taken under the management of the Forest Department, and particularly during the more recent years, much has been done to improve its condition, notwithstanding its defective situation. All possible efforts to encourage natural reproduction are being made. Roads have been to some extent cut through the forest, and at intervals spacious alleys have been made to serve as a means for arresting the march of destructive fires. A fire in this hill forest means terrible damage done to the standing stock, the advance growth, and the destruction of all fallen seed, the germ of future plants. Now the whole forest is divided into 8 parts, with cleared lines of 10 yards wide running from north to south, east to west, north-east to south-west, north-west to south-east, measuring in all 38 miles in length, thus giving scope for the easy arrest of fire, with the help of but a few men.

Fire in this forest is not generally the result of any natural causes. It is generally understood to occur from cattle tenders, who at their midday halts either to secure early and better growth of grass or for no reason whatever set a light to some dry grass, which in its turn communicates the flames to the underwood, and passing on through the long and tufted grass, in a little while the whole forest itself, covering each hill, forms an immense conflagration. Such sad occurrences are now put a stop to.

Though this hill forest cannot be compared with any of the evergreen forests in the west, and is but a scrub deciduous forest, it is important on account of its situation in an arid taluq like Arsikere, and its close proximity to the Railway. Trees of average growth and sufficiently large for ordinary house-building purposes are to be found in all low-lying places. The shrubby kinds are invaluable for fuel. The dominant species is bamboo (*Dendrocalamus strictus*), and the tree growth elsewhere is poor, both in quality and species, and the Forest Department is helping the reproduction

The timber, as a rule, is not of good quality and size, but is valuable in the absence of better kinds in the vicinity. There is, however, a good deal of advance growth at the lower levels: where this is wanting it is proposed to aid the natural reproduction artificially.

Teak seldom grows here much above 8 inches in diameter, the timber being much heavier and the concentric rings much closer together. This is probably due more to its growing on a hard laterite soil, the growth, however, being small and stunted, and having generally an appearance of arrested development. The Herikalgudda is peculiarly adopted for the growth of gallnut trees (myrobalams). In a favourable season the production of gallnuts has amounted to nearly 5,000 maunds, realizing Rs. 5,000 or more. The galls of this forest are much valued on account of their weight, their bright yellow colour and the greater percentage of tannin they are said to possess. These are sold at much higher rates than the nuts grown on trees elsewhere in the district if not in the province. Noticing the spontaneous growth of this tree in the forest, its speedy attainment of fruit-bearing power at the early age of 6 years, its longevity for upwards of 150 years as other arborescent plants, and the large revenue to be derived from it, all efforts to encourage reproduction are being directed towards Alale (*Terminalia Chebula*), the most valuable species in the forest.

The *Phyllanthus Emblica* grown here is noted for its flavour; and the size these gooseberries attain is immense, and is peculiar to Herikalgudda, and Herikalgudda alone, in the district.

The much-valued satinwood tree (*Chloroxylon Swietenia*) is found growing in this hill forest. These trees, though of large size are of great age, so that most of them are hollow and useless. Some measures to aid the natural reproduction of this plant may not be unprofitable.

Sandalwood grows in this forest among rocks where the soil is good, and the trees in such places though small contain more oil, and have a better perfumed wood, especially where the soil is red and stony. The soil of the Herikalgudda Forest being generally white, stony soil, Sandal arrives at maturity between 16 and 20 years; and though the growth is stunted, the wood is heavy and has an excellent scent, with a pale red color.

Tangadi (*Cassia auriculata*) is plentiful on the outskirts of of the hill, and bears flowers and fruits without cessation, and when in flower gives a brilliant colouring to the landscape. The royalty on the bark of this plant is fixed at Rs. 20 per cart-load; and there are many other products which can largely be developed, but for the inaccessible nature of the forest.

This State Forest has been supplying fuel for a few stations close to it on the S. M. Ry., and nearly 20,000 tons of fuel have been felled and removed. The cutting of fuel is conducted on coppice principles, and the forest coppice growth is expected to come up well.

Though this is a deciduous forest, the trees are only more or less deciduous in the dry months of January, February and March, and the forest is never entirely bare, for many trees burst into flower in February, and leaf themselves rapidly, before others have finished shedding their leaves. Still, these tracts have a forlorn appearance in the hot season. But in a favourable season this hill tract is not wanting in those charms of wood and water which tend to soften the harsher features of a rugged landscape, for though the summits rear themselves bare-headed, the slopes are tolerably clad with forest, through which the shining water-courses flow, and supply the vast expanse of tanks below. There are numerous kattays or depressions embanked for the collection of water throughout the hill.

Several systems of improvement of this forest are engaging the attention of the District Forest Officer. Under the systems contemplated, and under a regular system of carrying them out, this extensive hill forest will at some future date become a mine of wealth to the State.

To a shikaree this forest is not less enticing, for these rocky hills give shelter to numerous wild beasts, among which the tiger, cheeta, bear, spotted deer, wildpig and porcupine are most common.

N. N.

The Hill forests of Bashahr.

Bashahr is a hilly tract of land, stretching southward from the Chinese frontier down to Kotgarh in the Sutlej valley. On its west lies Kulu, separated from it by a vast chain of snowy mountains, and its eastern boundary rests upon that main ridge which forms a division between the Jumna and the Sutlej drainage areas. Simla, the largest sanitarium in the Punjab, better known as the summer capital of the Indian empire, is situated on this eastern ridge.

The whole country is drained by the Sutlej. Numerous streams which flow down Bashahr hills run into this river; the chief among these are the Baspa, the Wangar, the Ganwi and the Nogli rivers. The largest of all these tributaries is the Baspa river, which takes its rise from Chor Ghati, and joins the Sutlej at Karcham, some five miles above Kilba, at which latter place are the head quarters of the Bashahr Forest Divisional Officer.

Above Karcham the district divides itself into two valleys:

(1) The Baspa Valley, which adjoins the Jumna Valley.
(2) The Spoo valley.

Between these two valleys rises the mount Kailas, whose loftiest peak is above 21,000 feet high.

The whole district is rocky. The slopes exposed to south and east are generally without much soil on them. Such slopes are of course bare more or less according to their circumstances.

The slopes facing to west or north-west are, however, gentle and moist. The greatest part of these latter slopes is covered with forest growth. The rocks above Rampur are generally crystalline —either gniess, granite or mica-schist. The arable area is scanty, for which reason the district is not well populated.

The men are generally of idle habits. They still keep the old custom of polyandry among them, consequently a large number of females have to lead an unmarried life. And in the upper portion of the district, where Buddhism prevails, many females voluntarily become nuns.

It is of course a well-known fact that the character of the forest vegetation depends much on the influence of climate. Perhaps nowhere in the Punjab is the difference in the vegetation of the dry and moist regions so sudden and marked as it is in this district. I may therefore divide the Bashahr forests into two regions of climate—

(1) The forests below Wangtoo in the moist region, with an annual rainfall above 18 inches.

(2) The forests above Wangtoo in the dry region of climate.

It is of course true that besides climate there are other causes as well, such as soil, aspect and altitude, which have a great influence on vegetation in the hills, but it should be remembered that in this paper I would always speak of otherwise similar localities under these two different climatic divisions.

Before we cross Wangar bridge the appearance of the olive trees, which are found scattered on dry slopes all about there, brings home to our mind that we are now in the dry region of climate.

The following trees of the moist zone may be mentioned, amongst those which we leave far behind at *Nachar* and in the Ganwi and Nogli valleys where the rainfall, at least, during the rainy season, is often great. The holly, the grey oak (*Quercus incana*), *Albizzia julibrissin*, *Rhododendron arboreum*, *Rhus semialata*, *Corylus colurna*, *Andromeda ovalifolia*, *Symplocos cratægoides*, *Cornus capitata*, *Prunus Padus* and *Prunus Pudduam*.

Again there are others which extend to the vicinity of the dry zone, but gradually disappear at or near Wangtoo. The principal trees amongst these latter are the following:—

Pistacia integerrima, *Pinus longifolia*, *Æsculus indica*, the hill mulberry, *Acer caesium*, *Rhus Wallichii*, *Rhus Cotinus*, *Ulmus Wallichiana*, *Buxus sempervirens*, *Cedrela serrata*, *Cornus macrophylla*, *Quercus dilatata*, and *Q. semecarpifolia*.

The numerous shrubs such as *Zanthoxylum*, *Prinsepia*, *Berberis*, *Desmodium*, *Viburnum* and Brambles, as also various ferns and climbers of the moist climate all vanish in the dry region.

Now I proceed to consider the vegetation of the dry zone above Wangtoo. The following species are quite absent in the moist zone. They may be said therefore the most characteristic trees of the dry climate :—

Pinus Gerardiaxa Juniperus excelsa, Quercus Ilex, Olea cuspidata, a small leaved ash, the poplars, the almond trees, as also the different varieties of grape vines. But the most important trees of the Himalayas do not confine themselves to one zone of climate or the other, though they may not attain equal dimensions under both these circumstances. The principal individuals among them are the following :—The deodar, the blue pine, the two firs, the birch, the alder, the walnut, *Celtis australis* and the yew. Among the fruit trees, the apricot, the peach, the pomegranate, the pears, as also the Spanish chestnut may be mentioned as occuring both above and below Wangtoo.

Climbers are generally absent above Karcham, and ferns and grasses are scarce ; while amongst the shrubs some varieties of Indigofera are present.

As we penetrate further on into the dry region the number of already few species begins to decrease. Thus the yew disappears at Baring, the olive and the alder both vanish at Purbani, the two first hardly extend as far as Rispa, the deodar does not go further than Morung, while the only trees we find at Neysing are the birch, the edible pine, the apricot and the blue pine ; the last named tree is of course either very small or not unfrequently mere shrub. Thus, we see that some trees cannot exist without excessive moisture ; such are the Rhododendron, Andromeda, grey oak, &c. ; while there are others which extend to the vicinity of the dry zone and there disappear ; such as the horse chestnut, box and *Pinus longifolia.*

Again, there are some species which would hardly be found except in localities where the annual rainfall falls below 18 inches ; such as Q. Ilex and the Pencil Cedar, while there are still some which would grow both in the dry as well as in the moist climate. Deodar is one of such trees.

Again, some species belonging to the last class of trees grow equally well under both climates. For instance, the apricot starts below Simla, and extends far in the interior in the arid zone, while there are others among them which show a preference for either of the two climates. The blue pine may be mentioned as representing such trees. This pine which is very commonly found in Kulu, and extends over a very wide-spread area in the Nogli and the Ganwi valleys in Bashahr, and also forms extensive forests in the moist climate below Wangtoo, although it extends far to the vicinity of the arid zone, where the deodar does not approach it, is generally sparingly found in the dry zone of climate in the Spoo

Valley. I am inclined to believe that the real region of distribution of this pine is in the moist climate.

In the dry region above Karcham the deodar is found either almost pure or mixed with the edible pine, where the blue pine is sometimes either rare or quite absent.

The scarcity of this pine in such forests may be due to some other causes as well, the principal cause among which may be mentioned the soil.

As a rule the upper portion of the hills occupying the Spoo Valley holds very little soil, and generally remains under snow for the greatest part of the year. The lower slopes are of course in many places clothed with forest growth. Viewed from a distance the soil of these forest-clad areas looks more like that of the abandoned bed of a river than anything else. It is free as flour, and is generally very stony with a large admixture of sand, and contains a large quantity of mica as well. It seems to have been formed mostly by the distintegration of the crystalline rocks occupying the upper summits of these hills, and as a natural consequence therefore it follows that the soil of these localities is as dry as the climate itself.

To such dry climate and dry soil conditions the edible pine adapts itself very wonderfully. This pine is satisfied with the very poorest soil, and sometimes it requires little, or I may say, no soil at all. Hardly any fissures in the rocks remain unoccupied by this three-needled pine of the dry climate. In this one particular it may be said to out-do its sister pine of the moist climate, which it so closely resembles in all its habits.

Amongst other trees, which are sometimes found mixed with this pine under such circumstances may be mentioned Q. Ilex and the small leaved ash.

In such forests the deodar eventually gets in. The pine fosters it when the cedar is young, and simply disappears when it is no longer required.

To such process may be attributed the existence of almost pure deodar forests at Ralli, Tangling, Powari and other similarly situated localities in the Spoo Valley.

But the Blue pine refuses to persist under cover over head. The natural conditions, as regards both soil and climate, are also far from being favorable for the natural growth of this pine in the unshaded areas. Consequently, it is generally sparingly found in this valley. In places, however, where the soil is comparatively moist the blue pine is not much wanting; as an instance of such a type of forests may be mentioned the Mehbar and the Purbani forests of the dry zone of climate where fine specimens of it are present.

It may be true to some extent that both the climate and the soil account for the rareness of the blue pine in the Spoo Valley; but it is certain that under a more favorable climate the tree would have sooner occupied such a poor soil than any other species. I believe, therefore, that the real home of this pine is in the moist climate.

Should it ever be desired to introduce deodar in the above localities by some artificial means, it should never be attempted in places where the edible pine itself, or some of its companions, are not present. For instance, if we ever try to grow deodar in the Tangling or the Powari forests, where the rainfall during the monsoon seasons is almost *nil*, where not a single drop of water is present in the soil, and where the soil is as poor as it can possibly be, we should always, under such circumstances, use the edible pine as a nurse for the young plants of the cedar. Our all attempts to raise the deodar otherwise are sure to result in failure.

Similarly marked difference exists between the fauna of the moist and dry regions in this district. I believe, therefore, that a few words about these denizens of our forests may not be without some interest. The baboon, the barking-deer, the '*eemu*,' are quite absent above Wangtoo, where these animals are replaced by the sheep and the Ibex.

The little hardy monkey of the plains is not uncommon above Wangtoo, but the numerous pheasants of the moist zone are generally scarce, if not quite absent. On the other hand, the snow-pheasant, which we seldom find anywhere below Wangtoo, is not rare in the dry zone of climate.

The Chamois goat is also very sparingly found above Karcham, but the Thiar (the Kirth of Kulu) does not confine itself to one zone of the climate or the other, though it is seldom found far up in the valley. The musk deer is generally more commonly found in the dry zone.

Among beasts of prey the common leopard is generally sparingly met with above Karcham, while higher up in the valley the snow-leopard replaces it. The black bear is not so common in the dry zone as it is in the moist region, but the brown bear is not wanting above Karcham. Similar differences occur among the domestic animals of these two different zones.

Thus we see that climate is the most powerful element which regulates all important changes in the forests of this region.

KAILAS,

MIAN MOTI SINGH.

The 20th April 1894.

Note on the Occasional Formation of Pseudo-Autumnal Zones of Wood.

In Hartig's "*Anatomie und Physiologie der Pflanzen*," which I am now engaged in translating into English, the following passage occurs at page 261 :—

"Throughout the tropics many ligneous plants exhibit no 'definite annual rings because their cambial activity is never 'interrupted. Differences in the structure of the woody tissue, occa- 'sioned by changes in the temperature and in the humidity of the 'atmosphere, can still occur without indicating any definite limit as 'to the quantity of wood produced in each year. Other trees 'within the tropics, however, plainly exhibit annular rings, owing 'to the fact that at the commencement of the dry period a cessa- 'tion of vegetation takes place, which resembles the approach of 'winter in the temperate zones."

In the above passage a clear indication is given of the nature and cause of the occasional occurrence of what seem to be two annual rings during one season of vegetation. Thus, for example, during the hill tour of the students of the Forest School in the Jaunsar division at the present time, in counting the annual rings of deodar (*Cedrus deodara*) trees it is sometimes noticeable (*e. g.*, at Deota, elevation about 8,500 ft.) that a close autumn-like zone of dense tissue is to be found about the middle of the annual layer,—a zone that might easily be mistaken for an annual ring.

The explanation appears simple. During the winter months even the evergreen conifers do not *grow*, they merely transpire through their foliage. With the advent of warmer weather in spring and the stimulation of the root-system, owing to the rise of temperature in the soil, the active period of vegetation is entered upon. At first it is feeble, and during this stage a portion of the reserve nutrients stored up in the form of starch is re-transformed into grape-sugar and utilised for various constructive and expansive purposes ($C_6 H_{12}O_5 + O$ becomes re-converted into $C_5 H_{12}O_6$). But with the gradual increase in atmospheric temperature the energy of growth becomes enhanced, and during the latter half of April, throughout May, and until the advent of the monsoon rains at the end of June, or the beginning of July, the vegetative activity is decidedly great. In consequence of the bright sunshine and the high temperature the woody-fibrous tissue is rapidly developed, the cells expanding considerably so as to form a broad spring zone.

With the arrival of the rains, however, the vegetative energy receives a check owing to the decrease in the temperature, and to the fact that the humidity of the air approaches the point of saturation. Combined with these there must also be a decrease in the intensity of the rays of light ; but this may not be, and probably is not, so great as to interfere to any appreciable extent with the process of

assimilation. In consequence of the air being saturated with moisture during July and August the normal process of transpiration is directly interfered with. Despite the fact that, in order to stimulate transpiration, the stomata become enlarged automatically with any increase in the relative humidity if the air—just in the same way as they contract during very hot and dry weather, so as to decrease the rate of transpiration—it stands to reason that their task can only be very incompletely fulfilled when the whole of the woodland air has reached almost the limit of humidity, the point of saturation. With transpiration thus checked, assimilation cannot proceed as actively as was the case during the warm, dry months of April, May, and June; hence the cells of the wood formed during the two wet months of July and August expand less during the process of formation, and assume a dense appearance, closely resembling the true autumnal zone of the annual ring.

It will of course be apparent that, with this simultaneous fall in atmospheric temperature and diminution of vegetative activity, the *bark-pressure* will become increased, whilst the *counter-pressure* from within, *i.e.*, the expansive power of the cambial-cells engaged in the formation of new woody-fibrous tissue, will at the same time become weaker; and these conditions will considerably affect the size attained by the new cells in process of formation during the two wettest and coolest months of the S. W. monsoon season. Whenever the bark-pressure from without exceeds the counter-pressure from within, the formation of a pseudo-autumnal zone must take place; but when the opposite pressures are almost equal no such distinct line of demarcation need necessarily be visible. This would explain the fact that such pseudo-autumnal zones do not invariably run all round the periphery of the stem.

With the cessation of the heavy rains the relative humidity of the atmosphere decreases, and the temperature again increases considerably, so that during September and the early part of October there is a renewal of very active assimilation and of wider extension of the cells during the process of development. That is to say, after a dense pseudo-autumnal zone has been formed in July and August there follows a large-celled zone which appears, by contrast, to be a new layer of spring wood. During the autumn months, however, the true zone of autumn wood is produced normally, which plainly indicates the termination of active vegetation for the season, and shows that the tree has entered into the dormant period of the year.

In the Chir (*Pinus longifolia*) tracts of Jaunsar an analogous cessation of active growth during the wet and comparatively cold months of July and August makes itself felt with regard to the resin-tapping operations. The latter begin in the early part of May when once vegetative energy has become active. A good flow of resin, increasing with the temperature, continues till the air becomes cold and saturated with moisture in July. During July and August the result of this climatic change is that the outflow of resin

is practically *nil*. But it recommences with the return of brighter sunshine, great warmth, and diminished relative humidity of the air in September, after which it continues declining gradually, till the close of active vegetation for the year.

Now, resin may be produced in one of three ways, *viz* :—

(1) By transformation of the reserves of starch prepared and stored up during the more energetic period of growth;

(2) By transformation of cellulose through the absorption and fluidification of the cells contiguous to the resin-ducts; and

(3) In an indirect manner, by the destructive action of fungi permeating the woody-fibrous tissue,—

And as the *normal production* of resin is that indicated under (1), it therefore follows that the stoppage of the outflow of resin during July and August may reasonably be regarded as a direct consequence of the altered climatic conditions and of the interference, due thereto, with the normal processess of transpiration, assimilation, elaboration of sap, conversion of grape sugar $C_6 H_{12} O_6$ into reserves of starch $C_6 H_{12} O_5$ and transformation of a portion of these latter into the resin containing oil of turpentine $C_{10} H_{16}$ and colophony.

In connection with the above it may be anticipated that an examination of sections of the Chir Pine will likewise exhibit the pseudo-autumnal zones, previously referred to as occurring occasionally in the Deodar. Up till the present, however, no investigations have been made with regard to this subject.

The phenomenon of the formation of pseudo-autumnal zones during the summer months does not of necessity recur every year. On the contrary, from my examination of sections of Deodar grown in the Jaunsar highlands, their formation appears to be only of unusual occurrence. They will only be formed during years of excessively heavy rainfall in July and August, with relative humidity very near the point of saturation, and with an unusual decrease in the number of hours of sunshine and the intensity of the rays of light. It *may* be possible to count back, on the Deodar sections obtained during the present tour, in order to fix the years during which pseudo-autumnal zones have been formed, and then to compare these dates with the general meteorological returns for North-Western India. But it is impossible to compare any dates thus fixed with actual rainfall and temperature returns of the exact locality where the trees were grown, for such meteorological data do not exist. The majority of the forest trees in different parts of India are apparently able to carry on the vital processes without thus registering a silent record of the changing climate ; hence, wherever the pseudo-autumnal zones are discernible, this merely proves a less accommodative power in the given species of tree.

In the case of Sal (*Shorea robusta*) the annual rings of the mature wood are so indistinct that it is difficult to count them at

all ; but it is stated—a statement which I am not yet able either to confirm or to dispute—that young stool-shoots of this tree thrown out as coppice at Lakarkot on the Southern side of the Siwaliks (Saharanpur division), and known to be of a certain age, have apparently a larger number of dense (autumnal and pseudo-autumnal) zones of wood than corresponds with the number of years indicating their age. If this be the case, then the formation of these *pseudo-autumnal* zones must in all probability be ascribed to the climatic changes previously adverted to as occurring in July and August. The elevation of the Lakarkot coppice is about 1,500 feet, and the southern slopes of the Siwaliks receive the full burst of the monsoon, so that these climatic changes with regard to rainfall, temperature, humidity, duration of sunshine, and intensity of light will all be much more emphasised and strongly marked than if the forest growth were situated on the plains of India at a lower elevation, or even if it were on the northern slopes of the Siwaliks and at a somewhat higher elevation

It has been asserted that the Teak tree sometimes exhibits a number of concentric zones of woody tissue exceeding the number of years in the age that the poles are accurately known to have attained. In thinnings conducted throughout many of the Teak plantations of lower Burma I have never met with such a case. But it seems to me that if they can be proved, a very plausible explanation may easily be given.

In a former number of the *Indian Forester* I pointed out that the Teak plantations of lower Burma are occasionally liable to be almost totally defoliated during May by the caterpillar of an insect which seemed to me species of Tortrix (*Tortrix Tectonae*?), but which, as was pointed out by Major Bingham subsequently, really are two insects, *Hyblœa puera* and *Paliga damastesalis*. After a period of defoliation and dormancy, extending from about the beginning of February till about the end of March, the Teak flushes its spring foliage. In the hot day air of Burma during April and the early part of May the process of active vegetation is extremely energetic ; but, during years when the above caterpillars commit their ravages, the trees are practically stripped of their foliage before the end of May, and remain in a leafless condition till the summer flush of foliage comes out in July. Whilst the larvæ are feeding in countless swarms the normal processes of growth *must* be very seriously interfered with ; consequently the formation of a pseudo-autumnal zone of woody-fibrous tissue *may* be the result. Whether such a result actually occurs can easily be tested by examinations of the annual rings during the next thinnings, and by finding out from the plantation journal if any bad attacks of caterpillars took place during the years in which pseudo-zones appear to have been produced.

That such pseudo-autumnal zones of woody fibrous tissue are not infrequent in the case of many Indian trees seems to admit of

no doubt. And although it has no direct bearing on forestry, yet the matter is of much more than merely passing interest from a physiological point of view : hence it might be advantagous if men serving in different parts of India would kindly give their brother officers the benefit of any observations and deductions they may have made on the subject.

Camp Deota, Jaunsar
19*th May*, 1894

J. NISBET.

The Gutta-percha Industry.

(*From the "Revue des Eaux et Forêts," extract from "Le Bois" of* 10*th January* 1894.)

Although it is not a product of the forests of Europe, with which the following article deals, yet it is a matter of considerable interest to follow the course of a most curious industry, which is closely connected with electricity and sylviculture. It is well known that gutta-percha is an indispensable article in electrical engineering, as it is the only insulating substance which can be used as a protective covering for conducting wires where in contact with other objects. All endeavours to replace gutta-percha for this purpose have failed.

In 1889, its price was 9 francs the kilogramme, in 1890 it reached 13 francs, and in 1891 17 francs. To-day the price is still higher, and it is steadily increasing

Gutta-percha is almost exclusively obtained from Malaya, it is the sap of the *Isonandra Gutta*, a large tree which is fairly abundant in that region. The tree does not produce gutta-percha until it is full grown, *i. e.*, after about 30 to 35 years. Its height is then as much as 100 feet and diameter about 3 feet on an average.

The mode of extracting the gutta-percha as practised by the natives is very simple. The tree is first felled and allowed to remain for some time, then a strip of bark is cut off longitudinally, and from this cut the gutta-percha slowly flows. Tapping of standing trees has been tried, as is done in the collection of resin, in order to prolong the period of production, but without success, the sap refuses to flow until after the tree is dead.

The material obtained as above is in a more or less pure state, but from the natives it passes into the hands of the Chinese, who mix various other substances with it in order to increase the weight, and it is only available for use after it has further passed through the hands of a series of traders whose business it is to boil it and increase the volume at the expense of the quality. As a result of this, for some years past the quality of the gutta-percha commerce has been steadily deteriorating, and to obtain the same effect a large and larger quantity has to be used.

The method of extractions employed by the Malays presents another serious drawback as regards the future; and this is that as the trees are felled just at the time when they are becoming capable of producing seed, reproduction is prevented, and the forests are thus being rapidly depopulated. Attempts have been made to acclimatize the gutta-percha tree in other countries, and more particularly in the French colonies, and there are doubtless in the Indo-Chinese colonies, Madagascar, and perhaps even in Algeria, large tracts of land where the condition would be suitable for the growth of this tree, resembling as they do in most points the conditions which obtain in its native country. These endeavours are praiseworthy and deserving of encouragement, but they do not, nevertheless, provide for the urgent requirements of the present, for, as mentioned above, it requires 30 years for the *Isonandra Gutta* to attain that degree of maturity necessary for the production of gutta-percha; and however desirable it may be to provide for future requirements, the first thing to be done is to assure the present supply.

For this purpose, experts were sent from France to Malaya to study the question from an industrial point of view. These have recently returned; and from the information given in the last bulletin of the Society for the Encouragement of National Industries it appears that a solution is about to be arrived at. It was noticed that the flow of gutta-percha was obtained by allowing the felled tree to continue its vegetative functions for a time, so far as the performance of these functions is possible by the aid of the leaves which are not removed from the stem.

This fact suggested the possibility of the gutta-percha, which distils from the bark, originating, in the first instance, in the leaves themselves, and consequently the possibility of obtaining the gutta-percha direct from the leaves without felling the tree. Experiments have proved the correctness of this supposition. Both dry and green leaves have been submitted to chemical treatment with a view to separating out any gutta-percha which they might obtain, with the result that by a comparatively easy and cheap process a yield of 9% has been obtained.

The leaves of one tree entirely defoliated give as much as 1,000 to 1,100 grammes of gutta-percha, whereas the tree itself only yields 265 to 270 grammes. Supposing that not more than half the leaf cover is removed, the other half being left to support the growth of the tree, this will still give a yield double of that hitherto obtained. The product thus obtained is accepted by importers at the same rate as the old or original article, and apparently for commercial purposes the two are identical. Investigation is still going on, and leaves are being received from different quarters to be tested in the laboratories, so that a definite result should soon be obtained, and if the conclusions hitherto arrived at are thereby confirmed, it is certain that the price of gutta-percha will soon begin to fall rapidly.

A. F. G.

II.—CORRESPONDENCE.

Reduction of the Imperial Forest Service.

SIR,

In a recent issue of the *Forester* (April 1894) a correspondent expresses concern at the impending absorption of an appointment of Deputy Conservator on the Central Provinces—Punjab List of officers, in order to provide for a supernumerary Extra-Deputy Conservatorship which has recently been filled up on that list. The last published official list of officers does not make clear the facts of the case, which are as follows:—The appointment of Deputy Conservator, 4th grade, will be absorbed *only* when a vacancy in that grade occurs, to which the officer recently transferred to the Provincial Service might, by priority of claim, have been appointed had he remained on the Indian Forest Service list. An examination of the previous list should convince officers of the Indian Forest Service that their interests cannot be prejudicially affected by the issue of these orders. As, however, apprehension exists, I shall feel obliged by your inserting this letter in an early number of the *Forester*.

B. RIBBENTROP.

Pension Rules of Forest Officers.

DEAR SIR,

In the last Coopers Hill Prospectus it is laid down, that the more favourable pension rules have recently been extended to Secretary of State's forest men, and that a forest officer, who puts in 7 year's approved service as *Head of the Department* may therefore get an extra Rs. 1,000 a year pension. I cannot find that these provisions have been added to the Civil Service Regulations, and shall be glad to know if the Government of India has embodied them in any Resolution. Presumably, all the rules in Chapter XXIX of the C. S. Regulations will apply, and under article 714 of that Chapter all Conservators of 3 year's standing would be entitled to the extra Rs. 1,000 pension, and not merely the "Head of the Department—"a term, I take it, which refers only to the Inspector-General of Forests.

J. W. C.

III.—OFFICIAL PAPERS & INTELLIGENCE.

Grass-farming in Coimbatore.

Attention having been drawn to the operations of the Commissariat Department in Northern India in the matter of the growth of grass to supply the requirements of Military departments, chiefly by conserving wild land, it was considered advisable to obtain a full report on the system followed by private stock owners in the Coimbatore district in the laying down and management of permanent pastures. The report has been prepared by Mr. C. K. Subba Row, Sub-Assistant Director of Agriculture, and is given below. It may, however, not be out of place to quote here the following references to the custom and allied matters extracted from Mr. Nicholson's Manual of the Coimbatore District. He remarks that "a marked feature (of the agriculture practice) of 'much of the district is the fencing, which is almost peculiar to the 'Kongu country; it is found over most of Coimbatore, in parts of 'Salem, especially near Coimbatore, and in the Palni taluk of 'Madura. The habit of breeding large herds of cattle, the high 'winds, and the absence of any general custom of exchanging lands, 'probably induced this practice. From time immemorial large 'fields have been well fenced either with mullu-kiluvei (*Balsamo-'dendron Berryi*), something like a strong English bull-fincher, or 'with various species of Euphorbia and Cactus, including prickly 'pear. The practice of fencing is very valuable, cattle trespass be-'ing comparatively rare, cattle and crops protected, boundaries 'respected, large quantities of fuel supplied, and protection given 'to growing trees." The practice allows of the growth of pasture, regarding which he says:—

'This all-important subject receives little attention, though 'more than has been supposed. In taluks, such as Dhárápuram and 'Karúr, many fields are permanent pastures, either natural or sown. 'The fields, though stony, afford a good deal of pasture between 'June and February, but very little is to be found during the hot 'interval, and it is this trying break that, where forests and hills 'are not available, prevents cattle from thriving as they might; 'disease also frequently breaks out after the first rains, when the 'sudden growth of grass is greedily devoured. The herbage is 'coarse, wiry and tussocky, and there is no sward as in English 'pastures. Artificial pastures are comparatively rare, but in some

'taluks, notably the above two, the practice of ploughing and sow-'ing lands for pasture is practised. Hariali (*Cynodon Dactylon*) 'and an indigenous grass called kolei-kattei are sown, the latter 'most frequently; it is a very tall wiry grass, running rather to 'tussocks, so that a Coimbatore pasture little resembles those of 'England. It gives good feeding to judge by the prices paid. 'The lands are ploughed in the hot-weather rains and grass seed 'sown either by itself or mixed with cholum, gingelly, &c; if 'the north-east monsoon is good, cattle are turned in to graze in 'the following January, nine months after sowing; they graze 'through the hot weather till the early rains of the south-west 'monsoon. Grass is occasionally sown with gram in September, 'sometimes with kambu in July. The land is usually manured 'when the grass is sown, and thereafter the cattle grazing on it 'for several months in the year manure it. The pasture lasts for 'many years, and is then again ploughed and resown, or broken 'up for crops. Pasture growing is often a better speculation than 'crop growing, as a field of 8 or 10 acres will be grazed by as many 'cattle at from 4 annas to 1 rupee per month for several months. 'In addition to the grasses sown (usually hariali and kolei-kattei), 'other grasses, such as vennei, mattankáy (*Cynosurus egyptiaca*), 'ilei (*Panicum marginatum*), sourikodi, and naripayathán-kodi 'grow spontaneously. No attempt is made to adapt the soil or to 'use other grasses.

'It has been supposed that the district once abounded in good 'grass lands, that these have disappeared and been brought under 'cultivation, and that this, especially as regards the best pastures, 'was brought about by a change in the assessment some years ago, 'by which ryots, who had been accustomed to hold pasture lands on 'puttah at one-fourth of the assessment, were permitted to do so only 'if no other person was willing to take up the land for arable cul-'ture at the full rent.

'It must be clearly understood that the grass lands of which 'the ryots bemoaned the loss, and 'the jungle' supposed to have 'disappeared, are one and the same, *viz.*, the poorest dry lands 'wholly untilled and occupied and producing on their stony and 'sterile surface a few straggling and stunted bushes, and a little 'coarse, hardy grass. The better grass lands held ancestrally by 'the ryots have been broken up by their owners at their own plea-'sure and for their own profit, and the increase in occupied area 'has, on a comparison of existing facts with Mr. Hodgson's descrip-'tion, led to a great increase in tree growth."

The grass most commonly grown in the district is the *Kolei-kattei*, which the Government Botanist identified in 1887 as being the *Pennisetum cenchroides, Rich* Regarding this grass Mr. Duthie, in the Dictionary of the Economic Products of India, says that it is "a most excellent fodder grass, thriving best where the 'soil is sandy, in the Multan district it is considered to be the best 'grass to give to milch cows. Would probably repay cultivation."

Mr. Subba Row's report on the system of grass-growing in the district is as follows :—

"The origin of the name '*kolei-kattei*' as applied to the grass 'is obscure. '*Kolei-kattei*' literally means a preparation consisting 'of fried cocoanut scrapings or gingelly mixed with jaggery, en-'closed in a sac of rice flour and steamed, which is particularly 'acceptable to *Ganésa*. No part of the grass, however, presents 'any likeness to *kolei-kattei*. Some ryots were of opinion that the 'name of the grass is really *kolukkatti*, which means 'proof against 'the ploughshare,' as the grass is not liable to be exterminated by 'any number of ploughings, provided the roots are not gathered off.

'Owing to the long-continued drought, the grass was met with 'in tussocks, which were quite parched up. In Palayakottai, how-'ever, I saw it in a green state, about 1 foot high, amidst a cholum 'crop which had been manured with sheep manure.

'The grass has what is called a creeping stem with suppress-'ed internodes, the stalks above ground being really branches. 'Each plant tillers at every joint, corresponding to each leaf bud, 'where a separate set of roots is given off, making in all from 50 to '100 adventitious roots when well grown. The plant may be trans-'planted with success at any stage of growth. The Palayakottai 'Pattagar says that even when the grass has ripened its seed, it may 'be transplanted several hours after being pulled out, provided the 'roots are kept moist. The grass is stimulated to comparatively good 'and rapid growth by showers of rain too light to have any effect 'on other grasses. Though the grass may apparently die during a 'long-continued drought, it is revived by one smart shower. The 'vitality and propagating power of the grass are thus remarkable. 'The roots of the grass are very short, being scarcely three inches 'long even in very old pastures. The grass may, therefore, be 'easily cleared off the land by ploughing a few times and gathering 'off the roots.

'The great preponderance of dry land and the scarcity of 'hills are causes, so far as I can observe, of a large proportion of the 'occupied area being left waste for pasture and of large areas being 'cultivated with *kolei-kattei* grass, and of cholum and narippayir '(*Phaseolus trilobus*) being cultivated for fodder exclusively.

'Grey loamy soil, which, I believe, is rich in lime, is consider-'ed the best for *kolei-kattei* grass. Next comes red loamy or sandy 'soil with fine particles. Black cotton soils, which are com-'paratively friable, and soils derived from the disintegration of 'masses of agglomerated limestone, come next. Soils on old village 'sites, or fields which, on account of their close proximity to villages, 'are used by villagers as public latrines, are also very good. It is 'desirable that the land for *kolei-kattei* grass should have a gentle 'slope, so that rain water may drain off easily. If the slope of the 'land be not gentle enough, high bunds, like those of tanks, are 'raised so as to retain rain-water sufficiently long on the land and

'then let it off. Bunds constructed for this purpose (not only on 'account of the grass, but also on account of other field crops) are 'such a common feature in the Kángyam division as to lead to the 'supposition that tanks are very numerous there, until it is seen 'that the bunds have no sluices or waste weirs, and that there are 'no crop irrigated under them. I observed that on the low lying 'strip of land close to the bunds not a blade of *kolei-kattei* was to 'be found, stagnant water being particularly injurious to this grass. 'The grass is said to be spoiled if water stand on it for more 'than a day. I saw that hariali grass and *khanampul* had super-'seded *kolei-kattei* in the hollow places adjoining tank bunds. Stiff 'soil are unsuited to *kolei-kattei*.

'The grass is seldom sown by itself. As a rule, it is sown on 'the same land as and immediately after (1) gingelly, (2) cholum-'or (3) cumbu is sown, or (4) amidst a crop of *nadam* cotton in the 'last year of its growth. There are two seasons for sowing *kolei-'kattei* grass, *viz.*, the *kar* (from April to June) and the *paruvum* '(from August to October). Gingelly is said to be the best crop 'with which to sow the grass, and the *kar* season is preferable for 'sowing it. It is undersirable to stir the soil till three years after 'sowing *kolei-kattei* grass, and, as gingelly needs no interculture in 'the *kar* season, the grass is sown in the majority of cases 'immediately after gingelly. As a rule, the land on which the 'grass is sown is manured with sheep manure. Next to gingelly, 'cholum is the crop with which the ryots prefer to sow the 'grass. This may be done either in the *kar* or in the *paruvum* 'season. The grass gets a far better start and grows much better if 'sown in the *kar* than if sown in the *paruvum* season, provided there 'be good rainfall in that season. But, as the *kar* rainfall is pre-'carious, the grass is sown in most cases in the *paruvum* with 'cholum or more rarely with cumbu. In the latter case, it is only 'after the cumbu crop has been bullock-hoed that the grass seed is 'sown, interculture being essential for cumbu and destructive of the 'young grass. The grass seed is invariably sown on the surface, 'and the soil is not stirred afterwards, nor is the seed covered in. 'The seed should not be more than a year old.

'If the soil be moist enough, the seed germinates about six 'days after being sown. A shower of rain enables the grass to 'secure good hold on the soil. The grass is said to be benefited 'by the wind which blows pretty strongly from May to August, as 'it heaps up very fine soil against the stalks, which affords not only 'additional food to the plants, but also shelter to the roots. Two 'months after sowing, the grass begins to flower, and it is then as 'high as a man's waist. The Pattagar says that he has known the 'grass to attain a man's height under very favorable circumstances 'of soil and rainfall. About three months after sowing the grass 'seeds.

'As a rule, cattle are not let in to graze on the new fields till 'at least six months after sowing. If seed be sown in May or June,

'the grass will be fit for grazing by December, and if it be sown in 'July or August about February. In some cases cattle are allowed 'to graze immediately after the ears ripen and shed their seed; 'that is about four months after sowing. If cattle be let in too soon 'the plants may be pulled up by the roots on being grazed. Very 'great care is taken during the first year that neither sheep, goats, 'nor ponies have access to the grass, as these animals bite the grass 'close to the ground and thus kill it.

'*Kolei-kattei* grass-land is securely fenced with mullu-kiluvei '(*Balsamodendron Berryi*) against the trespass of cattle and sheep, 'which would otherwise keep the grass down. The size of an en- 'closure is never less than about 4 acres. On large estates where 'large numbers of stock of different kinds are kept, as at Palayakot- 'tai, the size of an enclosure may be 100 to 150 acres. Once in 'three years the fences are cut, when they present large gaps below, 'and the cuttings are in most cases planted close to the old fence so 'as to make it more dense.

'If the grass be sown in the *kar* season, cattle are let in to 'graze, as said before, about December, and go on grazing till 'March. They are then kept off the land till about a month after 'the grass has been refreshed by the next *kar* rains, and are then 'allowed to graze till rain falls in July or August. For about a 'month afterwards, the cattle are kept off the pasture, and then 'they go on grazing till even February or March. If there is more 'grass than the cattle can eat, it is cut before it becomes over-ripe, 'that is, soon after flowering. Grazing is generally available for 'cattle for about eight or nine months in the year from the 'second year forward. On large estates, like that of the Palayakot- 'tai Pattagar, breeding bulls and working cattle graze in separate 'enclosures, so that the vigorous and spirited bulls may not tease 'and injure the bullocks. Separated enclosures are also allotted to 'carrying and to empty cows; with the latter breeding bulls are 'allowed to run. The Palayakottai Pattagar says that two *vallams* 'or about 7½ acres of *kolei-kattei* grass afford sufficient pasture for 'a pair of cattle for about nine months in the year, *viz.*, for about 'three months in the *kar* season and about six months after the '*paruvum* rains have set in, and that the cattle would require to 'be fed with cholum straw or other fodder during the remainder of 'the year.

'Ordinarily, cattle are not left on pasture ground during the 'night, for fear of thieves and snakes. Young stock and cows ge- 'nerally graze from sunrise till sunset. Under such circumstances, 'a *vallam* (3·82 acres) of excellent land will support in good seasons '20 heads of cattle for 30 days on the whole during the year. So, 'about 2½ acres of good pasture in good seasons will give enough 'grazing for each head of cattle throughout the year.

'As said before, young stock and cows graze generally from 'sunrise till sunset. But from January to March they are turned

'out to graze at 3 or 4 A. M., for the grass, being then wanting in 'moisture, is best eaten when it is wet. with dew, and in the hot 'season also they are sent out to graze very early ; for, during the 'heat of the day, cattle leave off grazing and seek shelter under trees.

'Sheep are only allowed to graze the stubbles left after the 'cattle. The stubbles are said to be about a span high. Stock of 'all kinds thrive best on tender grass which renders the skin glossy. 'Ponies prefer hariali grass and do not eat *kolei-kattei* grass unless 'it is tender. Cattle thrive on *kolei-kattei* grass better in the *kar* 'season than in *paruvum*, although grass may be abundant in the 'latter season ; for they are worried by seekadi, an insect pest, and 'also do not drink water freely in *paruvum*

'Under average circumstances *kolei-kattei* grass appears to be 'rented at about Rs. 15 per *vallam* of 3·82 acres, the owner paying 'the assessment, which is about 12 annas per acre on the average. 'There is thus a profit of about Rs. 3 per acre.

'At intervals of three or five years the grass land is plough- 'ed immediately after a shower of rain at the end of the hot season, 'before the tussocks show signs of fresh growth. The furrows are 'ordinarily about four inches apart. The Palayakottai Pattagar says 'that he ploughs and *also cross-ploughs* his grass land at intervals 'of about five years, and that there is not the slightest danger of the 'grass being killed by close and repeated ploughing, unless mois- 'ture be wanting in the soil and rain hold off for long after the 'operation. When the grass has once matured its seed, no crop is 'usually sown on the land with the grass ; but I saw two extensive 'fields, sown with *kolei-kattei* grass years ago, cultivated with 'cholum this year, in Palayakottai. In one of the fields cholum 'was still standing, and on account of the tillage and the sheep 'manure which the land had received previous to cholum being 'sown, the grass was very luxuriant. This is very remarkable and 'interesting, considering the fact that nowhere else did *kolei-kattei* 'grass show any sign of life. Besides the tillage and the manure, 'the partial shelter afforded by the cholum plants accounts for the 'grass being in such comparatively good condition in these two 'fields As a rule, the only manure which *kolei-kattei* grass gets is 'the dung of the stock grazing it. On very high ground consist- 'ing of very inferior soil, it is said to be desirable to remove the 'grass altogether after a lapse of 10 to 15 years, and to resow the 'land. The grass is seldom irrigated.

'*Kolei-kattei* grass is sometimes cut and stocked. About three 'cuttings are obtained in the year. The yield per acre under favor- 'able circumstances appears to be 200 to 250 bundles, 9 feet in 'girth, per annum. The average yield is not less than 100 bundles 'per acre, and this, as each bundle of green grass is estimated to 'weigh about 50 lb. = about 2¼ tons.

'If land be simply left waste for a few years, grasses of va- 'rious kinds grow upon it ; but a given area of such land does not

ort half as much stock during the year as an equal area under *i-kattei* grass. The ryots do not appear to leave any block of d permanently waste as a rule ; each field appearing to get two three years rest in its turn. If a piece of land be once sown th *kolei-kattei* grass it is not advisable to bring it under cultivaon again in two or three years ; and, as the growth of the grass during the first year is not very good, there is no advantage in laying down the land under grass if it is to be cleared in a year or two, when it is well established."

The Principal of the College of Agriculture states in a recent report on this grass that, after some twelve years' experience at Saidápet, it has been found one of the hardiest grown there, and that apparently, if it once takes root, it does not die out easily. Even in April and May, the driest months at Saidápet, the plot under the grass is well covered.

Regarding the growth of fodder crops grown as such, which is a subject allied to the above, Mr. Nicholson in his Manual remarks that it is "rare, but the practice is known throughout 'the district and is occasionally followed. In the Kángyam divi- 'sion of Dhárápuram, where the best cattle are still reared, there is 'a regular practice in February-March of growing either cholum '(*Sorghum*) or cumbu (*Penuideum spicatum*) (chiefly the former) 'under well irrigation ; this is called adar cholum from its being 'sown closely so as to yield heavily, and is grown at any time that 'fodder may be wanted. It is cut down before earing and affords 'considerable provision during the hot weather. Fodder crops 'are not grown on dry land ; there is considerable pasture except 'in the hot weather, and as it is unusual to get rain sufficient 'even for ploughing from the end of December to 15th April, no 'such crops are possible except on garden lands. The ryot excuses 'himself from growing fodder by alleging, and with some reason, 'that, as his cholum fodder is little injured by growing to maturity, 'he grows cholum as grain crop rather than as a fodder crop for 'the double yield ; the expenses of well irrigation in the hot 'weather are considerable, and few could afford to lose the grain 'of the crop." (*Bulletin 2, Madras Agricultural Department.*)

Poona College of Science Calendar for 1894.

The Forestry Class at the Poona College was started in 1879, and opened with 12 students, but the numbers appear to have fallen off later on. Only matriculates are admitted, and a certain number of scholarships are given yearly for competition. The course lasts 1 or 2 years, and the annual fee is Rs. 50, in which respect the College differs from Dehra Dún, where there are no fees.

There are now two classes, leading respectively to the Forester ... of the Department.

The Forester class, under the Provisional Regulations, a only candidates who are above 18 and under 23 years of age have previously worked for 400 days at least in the worksho the College. At the end of the first year, the candidates examined in (1) Arithmetic, (2) Mensuration, (3) Surveying w compass and chain and plotting, (4) Materials used in Constr tion, (5) Elementary Botany, (6) Forestry ; and apparently thi is all, for the Calendar mentions no second year. Nor does there seem to be any out-door instruction or practical forest work at all The Ranger's class is admitted after a competitive examination in (1) Mathematics (Arithmetic, Algebra and Euclid), (2) Englis composition and hand-writing, (3) Reading and writing in a vernacular ; the students pay Rs. 25 per term as fees ; and the course is completed in two years when the final examination is held. This examination is in the following subjects :—

(1) *Mathematics and Natural Philosophy*

Paper No. 1. Algebra and Euclid.
„ „ 2. Trigonometry and Mensuration.
„ „ 3. Natural Philosophy.

(2) *Experimental and Natural Science.*

Paper No. 1. Heat.
„ „ 2. Physical geography, Mineralogy & Geology.
„ „ 3. Inorganic Chemistry
„ „ 4. Structural Botany
„ „ 5. Systematic Botany (with a practical test in the filling in of schedules)

(3) *Civil Engineering.*

Paper No. 1. Surveying (with a practical test in the Survey of about half a square mile)
Paper No. 2. Roads and earth-work
„ „ 3. Buildings.

(4) *Forestry*

Paper No. 1. Sylviculture.
Paper No. 2. Organization of Forests.
„ „ 3. Forest law.

There seems to be no oral examination, and no teaching of the important subject of Forest Utilization.

We have given the above sketch because we have often been asked to say what we know of the Poona curriculum, and think it will be interesting. For details of the courses, we must refer our readers to the Calendar which will show them that the Forestry is apparently treated as a minor subject, and that Poona students are expected to be very learned in Inorganic Chemistry and Heat, and need know very little indeed of Geology and nothing of

IV.—REVIEWS.

Indian Museum Notes Vol. III. No. 3.

The following information derived from these 'Notes' is of Forest interest.

(1) The winged form of the Bamboo Aphis (*Oregma bambusæ*, Buckton) see Vol. XIX p. 192, has been discovered in Ceylon on the yellow-stemmed *Bambusa vulgaris*. It is almost quite black.

(2) The longicorn beetle, which has the peculiar habit of girdling the branches and twigs of the trees has been discovered. It proves to be *Sthenias grisator*, Fabr. The specimens were obtained by the Deputy Conservator of Forests in Coorg (the late Mr. Foster) on rose trees. The following is the account given :—

"An interesting longicorn was forwarded through the Madras 'Museum in November 1892, by the Collector of Kurnool, with 'the information that it had been noticed cutting rings of consider- 'able depth and about an inch in diameter completely around the 'branches of a *Tabernaemontana alba* tree. The specimen has been 'identified through the kindness of Mr. C. Gahan, of the British 'Museum, as a female of the species *Sthenias grisator*, Fabr. 'Mr. Gahan notices that the male may be distinguished from the 'female by a small process projecting obliquely upwards from the 'base of each of the mandibles in front of the clypeus. He adds 'that the British Museum possesses a specimen taken more than 'thirty years ago near Coimbatore which bears a ticket with the 'following note—'gnaws the bark of shrubs and is very destruc- 'tive.'

"The same species was subsequently forwarded to the Indian 'Museum in January 1893 through the Imperial Forest School. 'In this case it was obtained by the Deputy Conservator of Forests, 'Coorg, who wrote :—'These beetles cut off the stem clean in 'one night.....Large rose trees are thus cut down and destroyed. 'It is incredible that a small insect like the one I send can do such 'damage, and I would not have believed it had I not seen their 'ravages myself.....I got them this morning from off the rose 'bushes they had destroyed. They attack the main stem and 'despise smaller branches.'

"The rose stems forwarded with the insects ranged from three 'quarters to half an inch in diameter, and were cut completely off [illegible]rkable neatness. The parent insect no doubt girdles [illegible]iew to afterwards laying its eggs above the notch.

'The habit is one that has been noticed with other species o
'same family, and exemplifies the fact that withering trees ar
'ones most frequented by longicorn borers, the supposition b
'that a vigorous flow of sap is liable to choke the larva in
'burrow."

(3) The following information is given regarding te
defoliators :—

"Both in 189 and 1892 damage was reported in the forest
'of the Hyderabad Assigned Districts by caterpillars which defoli-
'ated the teak trees.

'The specimens, which were forwarded to the Museum through
'the Forest Department in 1891, could not be identified at the time,
'as they were immature. They were preserved, however, for fur-
'ther investigation, and careful comparison with authenticated
'caterpillars since received from Burma shows that the insects in
'the two cases are identical. The species is the one referred to on
'page 94 of volume III of these *Notes* under the name of *Paliga*
'*damastesalis*, Walker. According to a report furnished by the
'District Forest Officer of Berar, the insect appeared in the early
'part of September, but information has not been received upon
'the subject of the extent of the damage that was occasioned.

'In 1892 the insect was a different one. It proves, from the
'specimens forwarded to the Museum, to belong to the species
'*Hyblœa puera*, Cramer. Injury commenced earlier, and a good
'deal of damage was done in the beginning of the rainy season. The
'attack is said to have been very severe in pure patches of teak,
'but was less noticed in areas where the forest was a mixed one.
'The trees that were attacked looked quite brown amongst the
'surrounding foliage, and ultimately lost their leaves, but a new
'flush of leaves soon appeared. When full fed the caterpillars were
'said to have let themselves down by silken strands and to have
'formed cocoons in the ground.

'The species *Hyblœa puera*, Cramer, has previously been
'recorded as attacking teak in Lower Burma, as well as in Dehra
'Dun, North-Western Provinces, and in the Kulsi plantation in
'Assam, so probably occurs throughout India."

(4) Another insect which was discovered by Mr. J. F. Bourdillon boring into teak trees in Travancore has proved to be a Bombyces moth, *Cossus Cadambœ*, Moore. The insect chiefly attacks softened unhealthy wood, not sound trees.

(5) A large cerambycid beetle, which has been discovered boring into *Farash*, *Sarin* and *Kikar* trees in the Punjab, proves to be *Neocerambyx holosericeus*, Fabr. It generally attacks the trunk near the ground, and the part affected is recognized by a swelling in the bark.

(6) A longicorn borer, found by the Conservator of Forests in Berar, boring into babul trees and doing great dam
been identified as *Celosterna spinator*, Fabr.

An American Working Plan

In November last an Editorial article appeared in *Garden and Forest*, from which we extract the following :—

"The time has already arrived, or, at least, it cannot be far 'distant, when timber-lands will be an inviting investment for those 'who wish to keep their forests for permanent cropping. He does 'not suggest the planting of forests from which the first returns 'are distant from thirty to a hundred years, although tree-planting 'by no means ought to be discouraged on the forestless prairies 'and in the plains country. Nor does he advocate the purchase 'of culled pieces of woodland from which the valuable timber has 'already been cut. But, inasmuch as it is possible, even now, 'to buy well-stocked virgin forest-lands which already contain 'a full-grown crop, half of which is valuable and accessible to 'large markets, for from $5,00 to $10,00 an acre, the more 'rational method would be to take this ready-made crop and apply 'to it systematic forestry. As the country has grown richer, the 'rates of interest have declined, and if Government bonds, on 'account of their safety and the ease with which the interest is 'collected, bring less than four per cent., the compounding of 'interest on forest-property, which is safe and increasing in value, 'may justify us in making our estimates at a still lower figure. 'The investor in such timber-land can at will draw interest, and 'he can anticipate it by taking advantage of favourable market 'conditions, and he can still have an investment capable of increas-'ing its yield, partly by the increased product under good manage-'ment, and partly on account of increased price for his product. 'To enforce this view, Mr. Fernow states that during the last forty 'years the price of wood has increased in Germany at the rate of 'from one and a half to nearly three per cent. a year. In Prussia, 'the price nearly doubled from the years 1830 to 1865, while 'between 1850 to 1891 it rose from three cents to nearly five cents 'a cubic foot for wood of all kinds and sizes. And since our 'virgin forest-supplies are being consumed at a rate which exceeds 'twice the capacity of the existing area to produce it, thrifty grow-'ing timber must surely increase in value. For long investments, 'therefore, timber-lands, under good forest-management, may even 'now be considered as equally profitable in the long run to timber-'lands which are bought for the purpose of culling out all that is 'good and leaving the forest in a worse condition than it was 'before."

In January 1894, there appeared in the same periodical, under the signature of Sir Dietrich Brandis, a confirmation of the above which we reproduce with pleasure :—

"I observe, in an editorial article of your issue for November '1st, that Mr. Fernow is quoted as recommending forest-lands under 'regular management for long investments. This is an idea which

'I have long held. Many circumstances seem to me to co-'operate in this direction These are:—

'(1) The low figure at which even untouched virgin forest-'land can be bought in certain places; (2) the steadily advancing 'price of timber; (3) the diminishing rate of interest; (4) the rise 'in the price of labor, which will be intensified by the restrictions 'placed upon immigration; (5) the growing desire to establish 'family property on a permanent basis.

'The increasing price of labor has already begun to make 'agriculture difficult, and it will become more so, except on virgin 'or exceedingly fertile soils. Forests require much less labor.

'All these facts tend to make it not unlikely that proprietors 'in some parts of the United States may eventually invest their 'money in forest-land, with a view, under regular management, 'of getting a moderate annual income, of steadily increasing the 'capital value of their estates and of eventually getting a large 'annual income. It seems to me that the man who first succeeds 'in setting the example in this respect, on a sufficiently large scale, 'will be the leader in what is destined to be a great movement."

Before the above had been read in India, we had received, for perusal, by the kindness of our Inspector General of Forests, a copy of a simple little working plan which had just been made by Mr. Gifford Pinchot, Consulting Forester (and, if we mistake not, a passed student of the Ecole Nationale Forestière at Nancy) for the Biltmore Forest in North Carolina, the property of Mr. George W. Vanderbilt, and this little work seems to point to the latter gentleman being the leader in such a movement as Sir D. Brandis refers to. From all we have heard and read, the dearth of timber and fuel is likely to be a very serious question in the United States before many years are out, and so it is a satisfaction that at least one proprietor has been found who is foreseeing enough to understand the value of a well-managed forest estate.

The Biltmore Estate lies on broken hilly land on both banks of the French Broad river, along which it stretches for about six miles, and occupies an area of 7,282 acres, of which 3,891 acres are woodland, constituting the Biltmore Forest. It is not regular in outline because it is interrupted by patches of cultivation. The rock is an ancient gneiss, with a considerable intermixture of pegmatitic quartz, and it readily disintegrates giving a rather stiff sandy loam soil, one which in spite of its depth is not very favourable to the growth of trees. The climate is temperate, the rainfall amounting to 43 inches yearly, while the temperature reaches its maximum of 99 degrees in July and its minimum of 6 degrees in December, and the relative humidity is least in May and greatest in January.

The trees which compose the forest are chiefly deciduous, and the chief of them is the White Oak (*Quercus alba*), after which came the black, scarlet and Spanish oaks (*Quercus tinctoria*, *Q. coccinea* and *Q. cuneata*). Then come the short-leaf pine (*Pinus echinata*), the chestnut (*Castanea sativa*), the hickory (*Hicoria*

sp. sp), the black gum (*Nyssa sylvatica*), the maple and the tulip tree (*Liriodendron tulipifera*); but their distribution has been much disturbed by human agency, the pine tending to encroach wherever a clearing exists.

Owing to previous bad treatment, the condition of much of the forest is poor, and thus the present condition of it comes under two heads : (1) where all ages are more or less completely present in all parts, and (2) where one age-class is distinctly predominant. In the former the *selection* system must be followed ; in the latter in order to prepare the way for a working plan under high forest, *improvement cuttings* are prescribed, with exclusion of cattle, protection from fire, and complete rest to those parts where the crop is too old for planted trees to compete with it successfully. So far, the improvement cuttings have been successful ; and after they have been completed it is proposed to work on the *Regular High Forest System* with a rotation of 150 years and as many sub-divisions. The number of compartments formed has been 92, and these are grouped in 3 blocks. For the first year's work there has been a deficit, which is expected to disappear later on.

An interesting addition to the estate is being made in the shape of an Arboretum of about 120 acres in the form of a strip 100 feet wide on either side of a 5 miles' drive, and in this it is intended to collect specimens of all the trees and shrubs that can be grown in the locality, collected from all the countries that can afford them, and in this way we believe India also has been indented on Such trees as are found to thrive are to be used in planting up about 1,000 acres of land which is at present unoccupied.

Mr. Pinchot's little working plan is profusely illustrated with excellent photographic prints of parts of the forest under management, and it is accompanied by a neat small map of the forest.

VI.—EXTRACTS, NOTES AND QUERIES.

Extraordinary Crop of Hirda fruit in Satara.

Mr. R. Fagan writes that in the past season, the crop of Hirda (*Terminalia Chebula*) on the Western Ghats in Satara has been in some ranges 50 per cent and in other 100 per cent over average. The general opinion is that the monsoon did not burst with violence, but came in gently at the time the fruit was setting, thus causing the increased crop. We should be glad to know if in other places the experience has been the same.

Comparative effects of lightning on different trees.

It is a well-known fact that lightning strikes some kinds of trees more than others. Thus, in America, oaks, ashes, white poplars, and elms are often struck, while beeches and walnuts very seldom suffer. Vines, cotton plants, and palms are peculiarly susceptible to lightning. There is also evidence to show that varieties of the same tree growing in different countries and climates differ in their immunity, probably owing to the quality of the wood and sap; so that statistics for one region may not be reliable for another. M. Dimitre has continued his experiments on this subject by subjecting specimens of living wood of equal dimension in the direction of their fibres to the spark from a Holtz electrical machine, and finds that oak is easily penetrated by it, while black poplar, willow, and especially beech, are much more resisting. In all these cases the heartwood is the least conductive. In fact, the starchy trees, poor in oil, such as oak, poplar, willow, maple, elm, and ash, offer much less resistance to the spark than beeches, walnuts, birches, and limes, which are "fat" trees. Pines, which contain a good deal of oil in winter, but have little oil in summer, are much more resisting in one season than the other. In summer time the wood is as easily pierced by the spark as oakwood, and in winter as difficult to penetrate as beechwood. When the oil of beech and walnut wood is extracted by ether the spark easily goes through. The dead wood of starchy trees is more easily pierced than the living wood, a fact which militates against the common idea that sap conducts the discharge. The bark and foliage of trees are, according to M. Dimitre, bad conductors. The above observations agree in a general way with statistics of lightning strokes in Europe. Thus, in the forests of Lippe, from 1879 to 1885 and in 1890, there were 159 oaks, 59 pines, 21 beeches, and 21 other kinds of trees struck.—(*Indian Agriculturist*).

The strongest timber.

The strongest timber known is the "Bilian" or Borneo ironwood, whose breaking strength is 1·52 times greater than that of English oak. By long exposure it becomes of ebony blackness and immensely hard. (*Scientific American*).—Can anyone tell us what the 'Bilian' is?

Obituary. C. C. Abbey.

It is with great regret that we announce the death of this promising young officer in the Oudh Forests, on the 19th May. Abbey only came out to India last year after a successful course at Cooper's Hill, from which he had passed out 2nd with a Fellowship. He was engaged on fire-protection work in Kheri and was riding along a 100 ft. fire-line when a Sàl tree, which had been girdled in the improvement fellings, fell upon him, killing both horse and rider. The accident was a most unprecedented one. His Conservator informs us that he had very favourably impressed him and his brother officers with his enthusiasm for his work, and that his death has caused great grief in his Circle. We are sure our readers will agree with us in deploring the sad accident which has lost us such a promising young officer.

VII.—TIMBER AND PRODUCE TRADE.

Churchill and Sim's Circular.

4th May 1894.

EAST INDIA TEAK.—The deliveries for the first four months of this year amount to 4,297 loads against 3,863 loads in the same period of 1893, but in the past April only to 729 loads against 1,092 loads for April 1893. The Dock Stock is very moderate, and there are many indications of improved special demands for this wood in the coming months. The floating supply is well disposed of some way ahead, but in the absence of general demand prices remain without more than a turn towards a higher level.

ROSEWOOD.—Stocks are sufficient for present limited demand.

SATINWOOD.—Figury logs of good sizes would sell well, but there is no enquiry for small, plain wood.

EBONY—Is in rather better demand, and there is no stock.

PRICE CURRENT.

Indian Teak	per load	£10.	to £16
Rosewood	„ ton	£5.	to £8
Satinwood	per foot superfical	6d.	to 12d.
Ebony	„ ton	£8.	to £15

MARKET RATES OF PRODUCTS.

(Tropical Agriculturist, May 1894.)

Cardamoms,	per lb.	2s.	to	2s.6d.
Croton seeds	per cwt.	20s.	to	27s.6d.
Cutch	,,	20s.	to	32s.
Gum Arabic, Madras	,,	15s.	to	35s.
Gum Kino	,,	£15	to	£18
India Rubber, Assam	per lb.	1s.7d.	to	2s.3d.
,, Burma	,,	1s.7d.	to	1s.11d.
Myrabolams, Bombay	per cwt	8s.6d.	to	10s.6d.
,, ,,	,,	4s.	to	4s.9d.
,, Godavari	,,	6s. 3d.	to	7s.
Nux Vomica, good	,,	6s.	to	10s.
Orchella, Ceylon	,,	16s.	to	22s.
Redwood	per ton	£3.	to	£3 10s.
Sandalwood, logs	,,	£35	to	55
,, chips	,,	£9	to	30

X.—EXTRACTS FROM OFFICIAL GAZETTES.

1.—Gazette of India.

3rd May, 1894.—No. 443-F.—In consequence of the death of Mr. R. H. C. Whittall, Conservator of Forests, 2nd grade, Punjab :—

Mr. A. E. Wild, Conservator, 3rd (officiating 2nd) grade, is confirmed in the 2nd grade.

Mr. P. J. Carter, Conservator, 3rd grade, Pegu Circle, Lower Burma, is appointed to officiate in the 2nd grade.

Mr. J. A. McKee, Deputy Conservator, 1st grade, Central Provinces, and Officiating Conservator, 3rd grade, is confirmed in the latter grade.

} With effect from 23rd February 1894.

Mr. E. Forrest, Deputy Conservator, 2nd grade, Punjab, officiated as Conservator, 3rd grade, in charge of the Punjab Forest Circle, from 26th February to 31st March 1894, both dates inclusive.

Mr. C. F. Elliott, Deputy Conservator, 1st grade, Beluchistan, is appointed Officiating Conservator, 3rd grade, Punjab, with effect from 1st April 1894, and until further orders.

Mr. A. M. Reuther, Deputy Conservator, 3rd grade, Punjab, is transferred temporarily to Baluchistan, *vice* Mr. Elliott, with effect from 26th March 1894.

No. 449-F.—The following reversions are ordered with effect from 22nd March 1894 :—

Mr. C. Bagshawe, Conservator of Forests, 2nd (officiating 1st) grade, Berar, to his substantive grade.

Mr. P. J. Carter, Conservator, 3rd (officiating 2nd) grade, Pegu Circle, Lower Burma, to his substantive grade.

No. 452-F.—Mr. J. A. McKee, Conservator of Forests, 3rd grade, Assam, is granted leave on medical certificate for eight months under Article 269 of the Civil Service Regulations, together with such subsidiary leave as may be admissable to him with effect from 2nd April 1894.

Mr. A. Smythies, Deputy Conservator, 2nd grade, North-Western Provinces and Oudh, and Deputy Director of the Imperial Forest School, is appointed Officiating Conservator, 3rd grade, Assam, with effect from 2nd April 1894, and until further orders.

Mr. J. Nisbet, Deputy Conservator, 1st grade, Burma, is appointed Deputy Director of the Imperial Forest School, with effect from 6th April 1894, and until further orders.

No. 457-F.—With reference to the Notification of this Department, No. 309-F., dated the 8th March last, Mr. A. E. Wild, Conservator, 2nd grade, relieved Mr. H. H. Davis, Officiating Conservator, 3rd grade, of charge of the Bengal Forest Circle, with effect from 8th April 1894, from which date Mr. Davis reverted to his substantive appointment of Deputy Conservator, 1st grade.

No. 459-F.—Mr. J. W. Oliver, Conservator of Forests, 2nd grade, Eastern Circle, Upper Burma, availed himself on the

afternoon of 31st March 1894, of the furlough granted him in the Notification of this Department, No. 294-F., dated the 28th February last.

Mr. P. J. Carter, Conservator 3rd grade, Pegu Circle, Lower Burma, is appointed to officiate in the 2nd grade, with effect from 1st April 1894, and until further orders.

Mr. T. H. Aplin, Deputy Conservator, 2nd grade, Burma, officiated as Conservator, 3rd grade, in charge of the Eastern Forest Circle, from 1st to 8th April 1894, both dates inclusive.

Mr. F. B. Dickinson, Deputy Conservator, 1st grade, Central Provinces, is appointed, on return from the furlough granted him in the Notification of this Department, No 339-F., dated 17th March 1893, to officiate as Conservator, 3rd grade, in charge of the Eastern Forest Circle, Upper Burma, with effect from 9th April 1894, and until further orders.

Mr. A Weston, Deputy Conservator, 3rd grade, Burma, officiated as Conservator, 3rd grade, in charge of the Tenasserim Forest Circle, Lower Burma, *vice* Major Bingham on privilege leave, from 1st March to 12th April 1894, both dates inclusive.

Mr. Aplin, Deputy Conservator, 2nd grade, Burma, is appointed to officiate as Conservator, 3rd grade, in charge of the Tenasserim Forest Circle, with effect from 13th April 1894, and until Major Bingham's return from leave.

11*th May*, 1894.—No. 507-F.—The services of Colonel J. C. Doveton, M. S. C., Conservator of Forests, Southern Circle, Central Provinces, are replaced at the disposal of the Military Department, with effect from the 10th April 1894.

25*th May*, 1894.—No. 564-F.,—With reference to the Notification of this Department, No. 507-F, dated the 11th May 1894, replacing the services of Colonel J. C. Doveton, M. S. C., Conservator of Forests, 1st grade, Southern Circle, Central Provinces, at the disposal of the Military Departement, with effect from the 10th April 1894 :—

Mr. C. Bigshawe, Conservator, 2nd grade, Berar, is promoted to the 1st grade.
Mr. R. H. E. Thompson, Conservator, 3rd (officiating 2nd) grade, Northern Forest Circle, Central Provinces, is confirmed in the 2nd grade.
} With effect from 10th April 1894.

Major C. T Bingham, Conservator, 3rd grade, Tenasserim Circle, Lower Burma, is appointed to officiate in the 2nd grade, with effect from 10th April 1894, and until further orders.

2.—Madras Gazette.

20*th April*, 1894.—Ranger C. Subramania Aiyar, from North Arcot District to the Cuddapah District.

M. Callanan, upon relief by C. Subramania Aiyar, from the Cuddapah District to the North Arcot District.

25*th April*, 1894.—Ranger V. C. Doraiswami Pillai will be considered to have been on leave on medical certificate, under Article 369 of the Civil Service Regulations, for fourteen days, from 23rd March 1894.

24*th April*, 1894.—No. 193.—Mr. C E. Brasier, District Forest Officer, Salem, is granted privilege leave for two months and twenty days, with effect from or after the 1st May 1894, under Article 291 of the Civil Service Regulations.

2*nd May*, 1894.—Mr. M. S. Noronha, Ranger on Rs. 60, South Canara, is granted privilege leave on medical certificate for six weeks, under Article 291 of the Civil Service Regulations, from 12th March 1894.

2*nd May*, 1894.—The following are the results for the Government students from the Southern Circle who went up to the Dehra Dun School in 1892:—

M. Panchapikesa Iyer, Forester, on Rs. 30, obtained the Higher Standard Certificate with Honours.

Mr. E. A. Monisse, Forester, on Rs. 40, obtained the Higher Standard Certificate.

Syed Edulla Saib, Acting sub. *pro tem.* Forester, on Rs. 30 obtained the Higher Standard Certificate.

Mr. C. V. Ryan, Forester, on Rs 40, obtained the Higher Standard Certificate.

T. V. Armugam Pillai, Acting sub. *pro tem.* Forester, on Rs. 30, obtained the Higher Standard Certificate.

C. S. Jesudasen Pillai, Acting sub. *pro tem.* Forester, on Rs. 30, obtained the Higher Standard Certificate.

5*th May*, 1894.—No 205.—In continuation of the leave notified at page 1002 of Part I of the *Fort St George Gazette*, dated 29th August 1893, Mr. C. G. Douglas, Deputy Conservator of Forests, Madras, has been granted an extension of leave, without allowances, up to the 23rd April 1894.

17*th May*, 1894.—No. 209.—

No.	Name of officers.	District.	Nature of charge.	Remarks.
1	Mr. F. C. L. Cowley-Brown, Assistant Conservator of Forests, 2nd Grade.	Salem	District Forest Officer.	To act during Mr. Brasier's absence on leave or until further orders.

17*th May*, 1894.—*Leave on medical certificate*—To Ranger T. Narayanaswami Aiyer, North Arcot, for 47 days, from 8th April 1894, under article 369 of the Civil Service Regulations.

19*th May*, 1894.—No. 223.—

No.	Name of Officers.	District.	Nature of charge.	Remarks.
...	Mr. H. H. Ward, Extra Assistant Conservator of Forests, Fourth Grade, Godavari.	Godavari.	Acting District Forest Officer.	During the absence of Mr. A. B. Jackson on privilege leave, or until further orders.

19*th May*, 1894.—No. 220.—Mr. A. B. Jackson, District Forest officer, Godavari, is granted privilege leave for three months, with effect from or after the 20th June 1894 under Article 291 of the Civil Service Regulations.

3.—BOMBAY GAZETTE.

25*th April*, 1894.—Mr. C. Greatheed, Divisional Forest Officer East Thana, delivered over, and Mr. A. N. Master, Extra Assistant Conservator of Forests. Fourth Grade, received, charge of, the Sub-Division Forest Office, Shahapur, on the 17th April 1894, before noon.

30*th April*, 1894.—Mr. A. N. Master, Extra Assistant Conservator of Forests, Fourth Grade, delivered over, and Mr. W. F. D. Fisher, Assistant Conservator of Forests, Second Grade, received, charge of the Divisional Forest Office, Panch Mahals, on the 12th of April 1894, in the afternoon.

30*th April*, 1894.—Mr. Lakshman Dai Joshi, Extra Assistant Conservator of Forests, First Grade, received charge of the Sub-Division Forest Office, Poona, from Mr. J. H. Clabby on the 21st of March last, after office hours.

2*nd May*, 1894.—No. 3064.—Mr. Balwant Ganesh Deshpande, Divisional Forest Officer, Ratnagiri, and Mr. Ganesh Sakharam Hinge, Extra Assistant Conservator of Forests, Satara, passed with credit, and Mr. Ardeshir Nasarvanji Master, L. C. E. Divisional Forest Officer in charge Panch Mahals, and Mr. A. C. Robinson, L. C. E., Sub. Divisional Forest Officer, Kolaba, passed an examination in Marathi according to the Lower Standard on the 16th April 1894.

Mr. W. F. D. Fisher, Assistant Conservator of Forests, Panch Mahals, passed an examination in Gujarati according to the Lower Standard on the 16th April 1894.

Mr. Nanabhai Dadabhai Sataravala, L. C. E., Extra Assistant Conservator of Forests, Working Plans Party II. S. C., passed an examination in Kanarese according to the Lower Standard on the 16th April 1894.

No. 3065.—Mr. Balwant Ganesh Deshpande, Divisional Forest Officer, Ratnagiri, Mr. Ganesh Sakharam Hinge, Extra Assistant Conservator of Forests, Satara, and Mr. Ardeshir Nasarvanji Master, L. C. E., Divisional Forest Officer in charge Panch Mahals, passed an examination in Marathi according to the Higher Standard on the 16th April 1894.

Mr. W. F. D. Fisher, Assistant Conservator of Forests, Panch Mahals, passed an examination in Gujarati according to the Higher Standard on the 16th April 1894.

Mr. Nanabhai Dadabhai Sataravala, L. C. E., Extra Assistant Conservator of Forests, Working Plans Party II, S. C., passed an examination in Kanarese according to the Higher Standard on the 10th April 1894.

8*th May*, 1894.—Messrs. L. S. Osmaston, Deputy Conservator, Fourth Grade, and F. R. Desai, Deputy Conservator, First Grade, respectively delivered over and received charge of the Divisional Forest Office, Nasik, on the 2nd instant, before office hours.

10*th May*, 1894.—Mr. T. B. Fry, Deputy Conservator of Forests, Second Grade, delivered over, and Mr. G. P. Millett, Deputy Conservator of Forests, Fourth Grade, received, charge of the Divisional Forest Office, Working Plans, Northern Circle, on the 10th of May 1894, before noon.

12*th May*, 1894.—Mr. W. R. Woodrow, Deputy Conservator of Forests and Divisional Forest Officer, Dharwar, availed himself of the furlough granted to him in Government Resolution No. 1638, dated 2nd March 1894, on the 5th instant, after Office hours, handing over his charge to Mr. J. Fairlie Muir, Collector, Dharwar.

15*th May*, 1894.—No. 4281.—His Excellency the Governor in Council is pleased to make the following appointments in the Forest Department:—

Mr. E. G. Oliver, on return from leave, to be Working Plans Divisional Forest Officer, Kanara.

Mr. C. M. Hodgson, on return from leave, to be Divisional Forest Officer, Sholapur.

15*th May*, 1894.—Mr. T. B. Fry, Deputy Conservator of Forests, Second Grade, and Mr. G. P. Millett, Deputy Conservator of Forests, Fourth Grade, respectively delivered over and received charge of the Divisional Forest Office, West Thana, on the 10th of May 1894, before noon.

16*th May*, 1894.—Mr. Krishnaji Babji Phadke, Extra Assistant Conservator of Forests, Fourth Grade, and Sub-Divisional Forest Officer, Kalyan, has been granted one month's privilege leave from the 6th of May 1894.

16*th May*, 1894.—Mr. K. B. Phadke, Assistant Conservator of Forests, Fourth Grade, and Mr. A. N. Master, Extra Assistant Conservator of Forests, Fourth Grade, and Sub-Divisional Forest Officer, Shahapur, respectively delivered over and received charge of the Sub-Division Office, Kalyan, on the 8th of May 1894, in the afternoon.

16*th May*, 1894.—With reference to Government Resolution No. 2025, dated 17th March 1894, Mr. Waman Gopal Tumne, Acting Extra Assistant Conservator of Forests, Fourth Grade, reported his arrival for duty in the West Khandesh Division on the 5th April last, after office hours.

18*th May*, 1894.—Mr. T. B. Fry, Deputy Conservator of Forests, took over charge of the Dharwar Forest Division from Mr. J. Fairlie Muir, Collector, Dharwar, on the forenoon of the 14th instant.

22*nd May*, 1894.—No. 4502.—The undermentioned officers passed on the 16th April 1894 the examination in Law prescribed in Rule 4 of the Rules published in Government Notification No. 2, dated 3rd January 1894, for the examination of officers of the Forest Department:—

Passed with Credit.

(1) Mr. Ganesh Sakharam Hinge, Extra Assistant Conservator of Forests, Satara.

Passed.

(2) Mr. Balwant Ganesh Deshpande, Divisional Forest Officer, Ratnagiri.

(3) Mr W. F. D. Fisher, Assistant Conservator of Forests, Panch Mahals.

The names are arranged in the order of merit.

23*rd May*, 1894.—Mr. Waman Ramchandra Gaunde, Extra Assistant Conservator of Forests, First Grade, and Mr. E. G. Oliver, Deputy Conservator of Forests, Fourth Grade, respectively delivered over and received charge of the Divisional Forest Office, Sholapur, on the 16th instant, after office hours, on the return of the latter officer from the privilege leave of one month which had been granted to him.

4.—Bengal Gazette.

26*th April* 1894.—No. 2350.—Mr. F. Trafford, Assistant Conservator of Forests, on return to duty from leave is posted to the charge of the Chittagong Forest Division, *vice* Mr. R. Quinnell, Extra Assistant Conservator of Forests, on privilege leave

8*th May*, 1894 —No. 2551.—Mr. E. G. Chester, Deputy Conservator of Forests, in charge of the Singhbhum Division, is granted one month's privilege leave, under Article 291 of the Civil Service Regulations, with effect from the 1st May 1894, or any subsequent date from which he may avail himself of it.

14*th May*, 1894.—No. 2653.—Mr. J. C. Mendes, Extra Assistant Conservator of Forests, attached to the Singhbhum Division, is granted one year's furlough, under Article 371 (*a*) of the Civil Service Regulations, with effect from 1st May 1894, or any subsequent date on which he may avail himself of it.

5.—N.-W. P. and Oudh Gazette.

29*th May*, 1894.—No. 1869.—Babu Karuna Nidhan Mukharji, Extra Assistant Conservator of Forests, in charge of the Gonda Forest Division, in the Oudh Circle, privilege leave for three months, with effect from the 25th May 1894.

29*th May*, 1894.—No. 1870.—Lala Har Swarup, Extra Assistant Conservator of Forests, attached to the Bahraich Forest Division, in the Oudh Circle, to the charge of the Gonda Forest Division in the same circle, during the absence on leave of Babu Karuna Nidhan Mukharji, or until further orders.

6.—Punjab Gazette.

2*nd May*, 1894.—No. 268.—With reference to Government of India, Revenue and Agricultural Department, Notification No. 45 F., dated 10th January 1894, Mr. H. S K. Edie, Officiating Assistant Conservator of Forests, 1st Grade, was transferred from the Central Provinces to Assam with effect from the 10th January 1894.

rd May, 1894,—No. 272·—Mr. C. P. Fisher, Officiating Deputy Conservator of Forests, on return from three months' privilege leave granted him in *Punjab Government Gazette* Notification No. 580, dated 15th November 1893, assumed charge of the

Kulu Forest Division from Mr. E. M. Coventry, Assistant Conservator of Forests, on the forenoon of the 12th April 1894.

5th May, 1894.—No. 278.—Consequent on his transfer to Baluchistan, Mr. A. M. Reuther, Deputy Conservator of Forests, made over charge of the Kulu Forest Division to Mr. E. M. Coventry, Assistant Conservator of Forests, on the afternoon of 15th March 1894.

8th May 1894.—No. 282.—Mr. C. F. Rossiter, Extra Assistant Conservator of Forests, 2nd Grade, is reduced to the top of the 3rd Grade of Extra Assistant Conservator of Forests, with effect from the 6th April 1894.

7.—Central Provinces Gazette.

24th April, 1894.—No. 2017.—With reference to Order No. 1744, dated the 10th April 1894, Colonel Doveton and Dr. E. Dobbs respectively made over and assumed charge of the current duties of the office of Conservator of Forests, Southern Circle, Central Provinces, on the afternoon of the 9th instant.

24th April, 1894.—No. 2047.—With the sanction of Her Majesty's Secretary of State for India, Mr. M Muttannah, Extra Assistant Conservator of Forests, 1st Grade, is appointed to be an Extra Deputy Conservator of Forests, 4th grade (supernumerary) on the Provincial Branch of the Upper Controlling Staff, with effect from the 1st April 1893.

14th May, 1894.—No 2.—The following passed stipendiary students of the Imperial Forest School, Dehra Dun, having complied with the conditions laid down in Section 29 (1) of the Forest Department Code, 4th Edition, are appointed Forest Rangers, 6th grade, on a salary of Rs. 50 per mensem, with effect from the 1st April 1894, and are posted to the Forest Division noted against their respective names:—

Mr. Shanker Nath	... Jubbulpore.
Mr. J. F. Anthony	... Saugor.
Mr. J. D. St. Joseph	... Betul.
Mr. C A. Webb	... Hoshangabad.

16th May 1894.—No 2310.—Mr. C. O. Hanson, Assistant Conservator of Forests, attached to the Direction Division, Southern Circle, is posted to the Nagpur-Wardha Division as Working-Plans Assistant.

15th May 1894.—No. 2311.—With reference to Order No. 2310, dated the 16th instant, Mr. C. O. Hanson relinquished charge of his duties in the Direction Division and assumed charge of his duties as Working-Plans Assistant on the forenoon of the 1st April 1894.

16th May, 1894.—No. 2312.—Mr. F. Linnell, Assistant Conservator of Forests, attached to the Direction Division, Southern Circle, is posted to the Seoni Division as Working-Plans Assistant.

16th May, 1894.—No. 2313.—With reference to Order No. 2312, dated the 15th instant, Mr. F. Linnell relinquished charge of his duties in the Direction Division on the forenoon of the 7th ultimo and assumed charge of his duties at Seoni on the forenoon of the 16th idem.

8.—BURMA GAZETTE—

23*rd April* 1894—No. 159.—In the last line of Revenue Department Notification No. 91, dated the 8th March 1894, *for* "Salween division" *read* "Salween-Attaran division."

23*rd April* 1894.—No. 160.—Mr. F. J Branthwaite, Officiating Deputy Conservator of Forests, is posted to the charge of the Prome Forest division.

No. 9.— With reference to Revenue Department Notifications Nos 103 a d 104, dated the 21st March 1894, Mr. C. H. Hobart-Hampden, Deputy Conservator of Forests, made over, and Mr. F. J. Branthwaite Officiating Deputy Conservator of Forests, received, charge of the Prome division on the afternoon of the 18th April 1894.

26*th April* 1894.—Mr. C. R. Dun, Assistant Conservator of Forests, is appointed to be Personal Assistant to the Conservators of Forests, Eastern and Western Circles, and is posted to the charge of the Direction Division, Mandalay.

27*th April* 1894.—No 167—Mr. D. H. Allan, temporary Forest Ranger, is appointed to be an Extra Assistant Conservator of Forests, on probation, and is transferred from the Pyinmana Forest division to the charge of the Gangaw subdivision of the Yaw Forest division.

30*th April* 1894—No. 3—With reference to Revenue Department Notification No. 492 (Forests), dated the 13th December 1893, Mr. C. R Dun, Assistant Conservator of Forests, reported his return from special duty in the Shwebo district on the afternoon of the 19th April 1894.

No. 4.—With reference to Revenue Department Notification No. 166 (Forests), dated the 20th April 1894, Mr. C.R. Dun, Assistant Conservators of Forests, assumed charge of his duties, as Personal Assistant to the Conservators of Forests, Eastern and Western Circles, on the forenoon of the 23rd April 1894.

3*rd May* 1894—No. 3.—Mr. C. Ingram, Extra Assistant Conservator of Forests, made over, and Mr. G. F R. Blackwell, Deputy Conservator of Forests, received charge of, the South Tenasserim division on the afternoon of the 24th April 1894.

4*th May* 1894.—No. 175.—Mr. C. Ingram, Extra Assistant Conservator of Forests, is transferred to Rangoon and posted to special duty in the office of the Conservator of Forests, Pegu Circle

No. 177—Under the provisions of Article 282 (*a*) (*i*) of the Civil Service Regulations privilege leave for three months and 15 days is granted to Mr A. M. Burn-Murdoch, Assistant Conservator of Forests with effect from the 6th May 1894, or the subsequent date on which he may avail himself of it.

No 178—Mr. R. M. Kavanagh, Extra Assistant Conservator of Forests, is transferred from the Mayadaung subdivision of the Katha Forest division to the charge of the Magwe subdivision of the Minbu Forest division.

8*th May* 1894.—No. 10—With reference to Revenue Department Notification No. 175, dated the 4th May 1894, Mr. C. Ingram, Extra Assistant Conservator of Forests, was on special duty in this office from the forenoon of the 4th to the forenoon of the 8th May 1894, when he proceeded to Port Blair.

9*th May* 1894.—No. 183.—Under the provisions of Article 282 (*a*) (*i*) of the Civil Service Regulations privilege leave for three months and 15 days is granted to Mr. C. R. Dun, Assistant Conservator of Forests, with effect from the 1st June 1894, or the subsequent date on which he may avail himself of it.

9.—ASSAM GAZETTE.

27*th April.* 1894.—No. 3096G.—Privilege leave of absence for one day, under Article 291 of the Civil Service Regulations, is granted to Mr. H. G. Young, Deputy Conservator of Forests, in extension of the leave granted in Notification No. 698J., dated the 2nd February 1893.

10*th May* 1894.—No. 3432G.—The following is published :—

The undermentioned officer has been granted by Her Majesty's Secretary of State for India permission to return to duty, as advised in List dated the 6th April 1894 :—

Name.	Service	Appointment	Date on which permitted to return.
Mr. W. F. Lloyd ...		Deputy Conservator of Forests, Assam.	Within period of leave.

18*th May* 1894.—No. 3647G.—On the report of the Central Examination Committee, the Chief Commissioner directs the publication, for general information, of the results of the Half-yearly Examination

of Assistant Commissioners, Extra Assistant Commissioners, and other officers held on the 7th, 8th, 9th, 10th, and 11th, May 1894 :

Name.	Subjects taken up by Candidates.		Subjects in which passed.		Compulsory subjects in which still required to pass.	
	Higher Standard.	Lower Standard.	Higher Standard.	Lower Standard.	Higher Standard.	Lower Standard.
FOREST OFFICERS.						
Mr. A. M. Long	Assamese ...	.....	Assamese ...	.....	.....	.....
,, F. E. B. Lloyd ...	Forest Law. Procedure and Accounts.		Procedure and Accounts. ...		Assamese .. Land Revenue. Forest Law.	.....
Babu Tara Kisor Gupta ...	Procedure and Accounts		Procedure and Accounts		....	.....
,, Kripa Nath De ...	Assamese ... Land Revenue,	....	Assamese ... Land Revenue.	.....	Forest Law. Procedure and Accounts.	

NOTE.—The last two columns are not meant to embody an exhaustive list of all the subjects and standards in which officers are liable to pass, and do not relieve any officer liable to examination, whether mentioned in this Notification or not, from the duty of ascertaining for himself the subjects and standards in which he is required to pass.

* The subjects marked with an asterisk are optional subjects, *i. e.*, not necessary to the retention of the officer's substantive appointmont.

25th May 1894—No. 3799G.—In continuation of Notification No. 3647G., dated the 18th May 1894, the Chief Commissioner directs, on the report of the Central Examination Committee, the publication of the results of the Half-yearly Examination held on the 8th and 10th May 1894 of the Forest Officer named below :

Name.	Subject taken up by the candidate.		Subjects in which passed.		Compulsory subjects in which still required to pass.	
	Higher Standard.	Lower Standard.	Higher Standard.	Lower Standard.	Higher Standard.	Lower Standard.
Babu Upendra Nath Kanjilal, Extra Assistant Conservator of Forests.	Procedure and Accounts, Forest Law.		Procedure and Accounts (with distinction). Forest Law (with distinction)		Assamese. Land Revenue.	

11 —MYSORE GAZETTE.

2nd May 1894.—No. 18301.—G. 4021.—Under Article 173 of the Mysore Service Regulations, Mr. B. Ramaswami Iyer, Sub-Assistant Conservator of Forests, Kolar District, was on casual leave for 11 days from the 21st of March 1894.

15th May 1894 —No. 19520—G. 4370.—The 1½ months' privilege granted to Mr. C. Narayana Rao, Assistant Conservator of Forests, in Notification No 16251—G 3581, dated 27th March 1894, is hereby extended by one month.

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